PART THREE: BONUS TOPIC-FOCUSED PRACTICE

The 20 full-length simulation exams in Part Two tested your readiness across all five ASE A8 domains simultaneously — exactly as the real certification exam will. Part Three shifts the focus. Rather than rotating through all domains at once, each bonus section isolates a single domain and delivers 10 targeted questions designed for concentrated, high-repetition review of that specific subject area.

This section is not a replacement for the full-length exams — it is a supplement. Use it strategically. After reviewing your performance across the simulation exams, identify the domains where your accuracy was lowest or your confidence was weakest. Return to those bonus sections for focused drilling before your test date.

Each bonus section mirrors the question style, difficulty level, and clinical precision of the full certification exam. Questions are written to challenge your applied knowledge — not just your ability to recognize a term. Expect scenario-based stems, realistic answer choices, and the same diagnostic reasoning demands you will face on exam day.

The five bonus sections are organized to match the five official ASE A8 domains:

- **Bonus Section A** — General Diagnosis
- **Bonus Section B** — Ignition System Diagnosis and Repair
- **Bonus Section C** — Fuel, Air Induction, and Exhaust Systems
- **Bonus Section D** — Emissions Control Systems
- **Bonus Section E** — Computerized Engine Controls Including OBD II

Each section contains 10 questions followed by a complete answer key with explanations. Work through each section as a timed mini-quiz, then review the explanations thoroughly — paying particular attention to why the incorrect options are wrong, not just why the correct answer is right. That level of understanding is what separates a technician who passes from one who truly masters the material.

BONUS SECTION A: GENERAL DIAGNOSIS

10 Questions | Focused Review

1. A vacuum gauge at idle shows a reading that fluctuates erratically between 14 and 20 in/Hg with no predictable rhythm or pattern. RPM is also slightly unstable. No misfire codes are stored. What does an erratically fluctuating vacuum needle MOST likely indicate?

A. A single cylinder misfiring on every firing event — the regular miss creates a rhythmic rather than erratic drop

B. Worn piston rings on multiple cylinders reducing pumping efficiency unevenly across firing events

C. A sticking or intermittently seating valve causing unpredictable vacuum variation with each affected cycle

D. A vacuum leak that opens and closes with intake manifold pressure pulses at idle

2. A compression test shows all cylinders between 155 and 168 psi. A cylinder leakage test performed immediately after shows cylinder 3 at 28% leakage — above the 20% maximum. Compression on cylinder 3 was 161 psi. Air is heard escaping faintly at the oil filler cap. What does air escaping at the oil filler cap during a leakage test indicate?

A. A head gasket breach between cylinder 3 and an adjacent oil passage allowing test air into the lubrication circuit

B. A cracked cylinder 3 piston allowing test air to pass directly into the crankcase through the piston body

C. A hairline crack in the cylinder 3 head allowing air to travel into the valley and exit through the filler opening

D. Worn or damaged piston rings on cylinder 3 allowing test air past the ring land into the crankcase, which vents through the oil filler

3. An engine has a consistent misfire on cylinder 2 confirmed by a contribution test. Compression is 165 psi on cylinder 2. Cylinder leakage is 5%. A new spark plug and coil on cylinder 2 do not resolve the misfire. Fuel injector pulse is confirmed. What should the technician check NEXT?

A. The cylinder 2 fuel injector for a restriction or spray pattern fault causing lean or poor-atomization misfires despite confirmed pulse

B. The cylinder 2 compression again using a different gauge — a 165 psi reading with a misfire suggests gauge inaccuracy

C. The PCM driver for cylinder 2 — a confirmed pulse with persistent misfire confirms a driver fault

D. The cylinder 2 head gasket for a breach causing intermittent compression loss not detectable on a static test

4. An engine produces a rhythmic ticking from the top of the engine at idle. The tick occurs twice per crankshaft revolution. Oil level and pressure are normal. What does a tick occurring twice per crankshaft revolution MOST likely indicate?

A. A worn main bearing producing one knock per revolution that echoes off the block

B. Two valves with excessive mechanical clearance — each valve ticks once per camshaft revolution, and with two affected valves the combined rate equals two events per crankshaft revolution

C. A single valve ticking on every intake and exhaust stroke simultaneously due to a collapsed lifter

D. Piston slap on one cylinder producing two audible impacts per revolution from both the thrust and anti-thrust sides

5. An engine has been diagnosed with a blown head gasket between cylinders 4 and 5. After head gasket replacement, a combustion gas block test is performed and returns negative. A compression test shows all cylinders between 158 and 167 psi. However, the cooling system loses 1 quart of coolant every 600 miles with no external leaks and no combustion gases in the coolant. What should the technician check NEXT?

A. The radiator for a hairline crack that passes combustion gas testing but allows slow coolant seepage under pressure

B. The water pump seal for a weep that only occurs under operating temperature and pressure conditions

C. The cylinder head for a crack allowing coolant to enter the combustion chamber without combustion gas crossover

D. The intake manifold gasket for a coolant passage breach allowing internal coolant loss without external evidence or combustion gas crossover

5. After head gasket repair, combustion gas test is negative and compression is normal on all cylinders. Coolant loss continues at 1 quart per 600 miles with no external leaks and no combustion gases detected. What should the technician check NEXT?

A. The radiator for a hairline crack passing combustion gas testing but allowing slow seepage

B. The water pump seal for a temperature-dependent weep

C. The cylinder head for a crack allowing coolant into the combustion chamber without combustion gas crossover

D. The intake manifold gasket for a coolant passage breach allowing internal loss without combustion gas crossover

6. A relative compression test is performed on a V8. Seven cylinders show consistent crank speed and amperage. Cylinder 6 shows significantly faster crank speed and lower amperage than all others on the compression stroke. The vehicle has a confirmed P0306 misfire. What does faster crank speed with lower amperage on cylinder 6 MOST likely indicate?

A. Cylinder 6 has severely low or no compression — the starter encounters minimal resistance and accelerates through the stroke, drawing less current

B. The cylinder 6 CKP reluctor tooth is damaged — the test equipment misreads the stroke duration for that cylinder

C. The cylinder 6 injector is flooding the cylinder — excess fuel reduces compression resistance and lowers amperage

D. The relative compression tester has a calibration fault specific to the cylinder 6 firing position

7. An engine has a knocking sound that is loudest when the engine is cold and under light load at approximately 1,200 RPM. The knock diminishes significantly at idle and disappears entirely under heavy load. Oil level and pressure are normal. What does a knock most prominent at light load and specific RPM that disappears under heavy load MOST likely indicate?

A. A worn connecting rod bearing — rod knock increases under load, not decreases

B. Piston slap — piston slap is loudest when cold but does not disappear under heavy load

C. Detonation — detonation requires combustion load to occur and would worsen under heavy load, not disappear

D. Torque converter clutch shudder or a driveline component resonating at a specific RPM under light load — the knock disappears under heavy load because load changes the resonant condition

7. A knock is loudest at light load around 1,200 RPM when cold and disappears entirely under heavy load. Oil pressure is normal. What does this MOST likely indicate?

A. A worn connecting rod bearing — rod knock increases with load

B. Piston slap — loudest cold but does not disappear under heavy load

C. Detonation — worsens under load, does not disappear

D. A driveline or torque converter component resonating at a specific RPM under light load — disappears when load changes the resonant condition

8. A technician performs a snap-throttle vacuum test. The vacuum drops sharply to near zero at snap-throttle. On the rebound, the vacuum rises to only 16 in/Hg before settling at the idle baseline of 18 in/Hg — the rebound does not exceed the baseline. What does a rebound that fails to exceed the idle baseline MOST likely indicate?

A. Restricted exhaust — backpressure absorbs the rebound energy that should momentarily exceed baseline

B. Weak valve springs — the springs cannot close the valves rapidly enough to produce a vacuum rebound above the idle baseline

C. Retarded ignition timing — retarded timing reduces the pumping efficiency that produces the snap-throttle rebound

D. Normal variation — a snap-throttle rebound at or near baseline is acceptable on a mechanically sound engine

9. A cooling system pressure test is applied at 16 psi. After 20 minutes the pressure holds at 16 psi. There are no external leaks. No combustion gases are found in the coolant. The engine consumes 1 quart of coolant every 400 miles. Exhaust has a faint sweet smell under certain operating conditions. What should the technician check NEXT?

A. The radiator for a pinhole leak that only opens under sustained operating temperature, not during the cold pressure test

B. The thermostat housing gasket for an internal leak allowing coolant to bypass the test point

C. The intake manifold gasket on this vehicle's engine for a coolant passage breach that allows coolant into the combustion chamber — a common failure mode on certain V6 and V8 engines that produces a sweet exhaust smell without combustion gas crossover

D. The heater core for an internal leak routing coolant into the HVAC system and out through the cabin, not detectable externally

9. Pressure test holds at 16 psi. No external leaks. No combustion gases detected. Coolant consumption is 1 quart per 400 miles. Exhaust has an intermittent sweet smell. What should the technician check NEXT?

A. The radiator for a pinhole leak that only opens under operating temperature

B. The thermostat housing gasket for an internal bypass leak

C. The intake manifold gasket for a coolant passage breach — a common failure mode on certain V6 and V8 engines producing sweet exhaust without combustion gas crossover

D. The heater core for an internal leak routing coolant into the cabin undetected externally

10. An engine has blue smoke only during the first 30 seconds of cold start that completely clears as the engine reaches operating temperature. Oil consumption is minimal — less than 1 quart per 3,000 miles. Compression and leakage are confirmed normal on all cylinders. What is the MOST likely cause?

A. Worn piston rings allowing oil consumption only during the cold-start period before ring seal improves with thermal expansion

B. A stuck-open PCV valve drawing excess oil mist into the intake during the high vacuum of cold-start idle

C. Valve stem seals that have hardened or shrunk with age, allowing oil to migrate down the valve stems during shutdown and burn off immediately at cold start

D. A head gasket breach allowing oil from the lubrication passages to enter one or more combustion chambers during the cold-start period only

BONUS SECTION A: ANSWER KEY AND EXPLANATIONS

1. **C. A sticking or intermittently seating valve** — An erratically fluctuating needle with no predictable rhythm is the pattern of a valve that intermittently sticks open or fails to seat consistently. Because the sticking is unpredictable, the vacuum drop has no regular interval or magnitude. A single cylinder misfire produces a rhythmic evenly spaced drop; a vacuum leak produces a steady depressed reading.

2. **D. Worn or damaged piston rings on cylinder 3 allowing test air past the ring land into the crankcase** — Compression at 161 psi confirms the rings seal during slow cranking speed. However, 28% leakage on a static test confirms they cannot hold a sustained seal. Air escaping at the oil filler confirms the leak path is through the ring land into the crankcase, which vents through the filler opening — the defining pattern of rings that seal during cranking but fail under sustained static pressure.

3. **A. The cylinder 2 fuel injector for a restriction or spray pattern fault** — Compression, leakage, spark plug, and coil are all confirmed normal or replaced. Injector pulse confirms the electrical command is reaching the injector. A confirmed pulse does not confirm fuel volume or spray quality — a restricted injector or one producing a solid stream rather than an atomized mist causes a lean misfire despite correct pulse, compression, and ignition.

4. **B. Two valves with excessive mechanical clearance** — Each valve opens once per two crankshaft revolutions. Two separate valves with excessive clearance each produce one tick per camshaft revolution — two audible events per crankshaft revolution combined. A single valve fault produces one tick per two crankshaft revolutions. Main bearing knock and piston slap occur once per crankshaft revolution, not twice.

5. **D. The intake manifold gasket for a coolant passage breach** — The negative combustion gas test and normal compression confirm the repaired head gasket is sealing correctly. On many V6 and V8 engines, the intake manifold gasket also seals coolant passages — a breach in the coolant section allows internal coolant loss into the lifter valley or oil passages without producing combustion gases in the coolant or any external puddle.

6. **A. Cylinder 6 has severely low or no compression** — The starter works harder — drawing more current and slowing crank speed — against a cylinder with normal compression. When a cylinder has no compression, the starter encounters no resistance, accelerates through the stroke faster, and draws significantly less amperage. Faster crank speed with lower amperage on cylinder 6 is the direct electrical signature of a complete compression failure, consistent with the confirmed P0306.

7. **D. A driveline or torque converter component resonating at a specific RPM under light load** — A knock that disappears entirely under heavy load is not consistent with any internal engine fault. Bearing knock increases with load. Piston slap persists under load. Detonation worsens under load. A sound existing only at a specific light-load RPM that disappears when torque increases is a resonance phenomenon — a torque converter shudder or loose driveline component damped when load increases.

8. **B. Weak valve springs** — The rebound above baseline occurs because strong valve springs rapidly close the valves against the vacuum spike at throttle closing. Weak springs cannot close the valves quickly enough, allowing bleed-back past the slowly closing valves — reducing the rebound below baseline rather than producing the expected above-baseline spike.

9. **C. The intake manifold gasket for a coolant passage breach** — A perfect pressure hold and negative combustion gas test confirm no external leak and no combustion-side breach. A sweet exhaust smell without combustion gas crossover is the specific pattern of an intake manifold gasket coolant section failure — coolant enters the combustion chamber through the intake side, burns, and exits as sweet steam without allowing combustion gases to travel back into the coolant.

10. **C. Valve stem seals that have hardened or shrunk with age** — Blue smoke only during the first 30 seconds of cold start with minimal overall consumption is the pattern of aged stem seals. During shutdown, oil migrates past the degraded seals and pools on the valve heads. At cold start, the pooled oil burns immediately producing brief blue smoke. Once consumed, no further visible oil passes — smoke clears completely. Normal compression and leakage confirm rings are not involved.

BONUS SECTION B: IGNITION SYSTEM DIAGNOSIS AND REPAIR

10 Questions | Focused Review

1. A spark plug removed from an engine shows a black, wet, shiny deposit on the insulator and electrode with minimal electrode erosion. What does this MOST likely indicate?

A. Carbon fouling from excessive idling

B. Fuel fouling from a flooding condition

C. Pre-ignition damage

D. Oil fouling from oil entering the combustion chamber

2. A secondary ignition scope shows one cylinder with a significantly lower firing line and longer arc duration than all others. What does this pattern MOST likely indicate?

A. A wide plug gap

B. A fouled or carbon-tracked spark plug

C. A weak coil on that cylinder

D. A high-resistance plug wire

3. A Hall effect CKP sensor signal wire reads 0 volts at rest with the sensor connected. No switching occurs during cranking. Reference voltage and ground resistance are both confirmed correct. What does the 0-volt signal at rest confirm?

A. The CKP trigger wheel is missing teeth

B. The PCM CKP input has failed

C. The CKP signal wire has a short to ground

D. The CKP sensor ground is open

4. A COP coil has primary and secondary resistance both within specification. The coil produces no spark on a spark tester. What should the technician check NEXT?

A. The PCM driver command wire for a fault preventing the firing command from reaching the coil

B. The coil secondary tower for carbon tracking

C. The coil ground connection for high resistance

D. The coil primary winding for an intermittent open

5. A distributor ignition system has correct base timing with the advance connector unplugged. At 2,500 RPM with the connector reconnected, total advance is only 8° above base against a specification of 22–28°. What does this indicate?

A. A faulty ignition module at elevated RPM

B. A vacuum advance unit not contributing to total advance

C. A PCM fault sending an insufficient advance command

D. A distributor advance mechanism fault

6. A COP primary waveform shows one cylinder reaching magnetic saturation earlier in the dwell period than all others. What does early saturation during dwell indicate?

A. The PCM is commanding longer dwell on that cylinder

B. The coil primary winding has lower than specified resistance

C. The coil primary winding has higher than specified resistance

D. Elevated coil supply voltage on that cylinder

7. A lab scope of a magnetic reluctance CKP sensor at idle shows consistent tooth amplitude throughout, with a larger amplitude signal at the reference gap position every revolution. No codes are stored. What is the correct interpretation?

A. Normal operation — larger amplitude at the reference gap is expected for a magnetic reluctance sensor

B. The sensor is over-sensitive at the reference gap position

C. An extra tooth exists at the reference gap position

D. The PCM is injecting a reference pulse at the gap position

8. A spark plug from cylinder 5 shows normal insulator color, a flat worn center electrode, rounded edges, and a gap of 0.065 inches against a 0.044-inch specification. The plug is at 60,000 miles on a 100,000-mile iridium plug. What is the correct interpretation?

A. Replace immediately — the gap above specification causes misfires regardless of service life

B. The plug shows pre-ignition damage

C. Normal wear for an iridium plug at 60,000 miles — gap growth and electrode rounding indicate replacement is needed

D. Re-gap to specification and return to service

9. A P0351 coil A active code is stored. Supply voltage is 12.4 volts. The command wire drops only 0.2 volts when the PCM commands the coil. No spark is produced. What does the minimal voltage drop on the command wire confirm?

A. The PCM driver has failed open

B. The coil A primary winding is open — an open primary limits current flow and restricts the driver's pull-down to a minimal drop

C. High supply circuit resistance is limiting available voltage

D. The PCM driver is functioning correctly

10. A waste spark DIS coil fires correctly on the cylinder 3 tower but produces no spark on the cylinder 6 tower. Supply voltage and command signal are both confirmed correct. What should the technician check NEXT?

A. The cylinder 6 spark plug for severe fouling

B. The cylinder 6 coil secondary winding for an internal open on the cylinder 6 tower

C. The PCM driver for the cylinder 3/6 coil position

D. The cylinder 6 plug wire for an open in the secondary circuit

BONUS SECTION B: ANSWER KEY AND EXPLANATIONS

1. **D. Oil fouling from oil entering the combustion chamber** — A black, wet, shiny deposit with minimal electrode erosion is the signature of oil fouling. Oil burns onto the insulator as a wet, glossy black coating. Carbon fouling is dry and sooty. Fuel fouling is wet but lighter in color with a fuel odor. Pre-ignition produces a white blistered insulator with severe electrode erosion.
2. **B. A fouled or carbon-tracked spark plug** — A conductive path parallel to the plug gap reduces the voltage required to initiate the arc — lowering the firing line. The available coil energy then dissipates through the parallel path rather than sustaining a clean arc, producing the extended apparent duration. A wide gap raises the firing line; a weak coil produces both a low firing line and brief duration; wire resistance raises the firing line.
3. **C. The CKP signal wire has a short to ground** — A functional Hall effect sensor output switches between 0 and reference voltage as teeth pass. With reference voltage and ground both confirmed correct, a signal wire reading 0 volts at rest with no switching confirms the wire is being held at ground by an external short — preventing any switching regardless of sensor output.
4. **A. The PCM driver command wire for a fault preventing the firing command from reaching the coil** — Both primary and secondary windings are confirmed intact by resistance testing. With the coil internally correct, the fault must be in the circuit delivering the firing command. No firing command reaching the coil produces no spark regardless of coil condition.
5. **D. A distributor advance mechanism fault** — Correct base timing confirms the distributor is correctly positioned and the module is functional. Severely reduced total advance at 2,500 RPM with correct base timing confirms the advance mechanism itself — centrifugal weights, springs, or vacuum unit — is not adding advance as commanded.
6. **B. The coil primary winding has lower than specified resistance** — Current rise rate during dwell is determined by primary winding inductance, which is directly related to resistance. A lower-resistance primary winding allows current to climb faster than designed, reaching magnetic saturation earlier in the dwell period than all other correctly-specified coils.
7. **A. Normal operation — larger amplitude at the reference gap is expected** — A magnetic reluctance sensor generates amplitude proportional to the rate of magnetic field change as each tooth passes. The reference gap is wider than standard tooth gaps — the larger transition from tooth to wide gap produces a stronger field change and correspondingly larger amplitude signal. This is a designed feature used by the PCM to identify crankshaft position.

8. **C. Normal wear for an iridium plug at 60,000 miles — replacement is indicated** — Gap growth and electrode rounding are expected wear patterns at the midpoint of a 100,000-mile iridium plug's service life. The gap has grown beyond specification, confirming replacement is needed. The normal insulator color rules out pre-ignition. Iridium fine-wire electrodes cannot be re-gapped without damage.
9. **B. The coil A primary winding is open** — A command wire that drops only 0.2 volts when the driver is commanded confirms the driver transistor is attempting to pull the circuit to ground but encountering an open circuit. An open primary winding prevents current flow through the coil — with no current path, the driver cannot pull the circuit fully to ground, producing the minimal voltage drop despite a functioning driver.
10. **D. The cylinder 6 plug wire for an open in the secondary circuit** — A waste spark coil that fires correctly on one tower but not the other with confirmed supply voltage and command signal has eliminated input faults and coil primary function. The fault is in the secondary delivery circuit on the non-firing tower. The plug wire is the most accessible secondary component between the coil tower and the spark plug and should be tested before condemning the coil secondary winding.

BONUS SECTION C: FUEL, AIR INDUCTION, AND EXHAUST SYSTEMS

10 Questions | Focused Review

1. A port injection engine has correct fuel pressure at key-on. After a 10-minute hot soak, the engine cranks normally but requires 4–5 seconds of cranking before starting. Fuel pressure at the start of cranking is 0 psi and builds slowly. What is the MOST likely cause?

A. A faulty fuel pressure regulator bleeding pressure into the intake manifold during hot soak

B. A failed fuel pump check valve allowing complete pressure drain-back to the tank during hot soak

C. Leaking fuel injectors bleeding pressure during hot soak requiring extended cranking to rebuild

D. A fuel pump relay fault causing delayed pump activation at the start of cranking

2. A scan tool shows LTFT at +19% on bank 1 and +2% on bank 2 at idle. At 2,500 RPM, bank 1 LTFT drops to +4%. Fuel pressure and injector balance on bank 1 are confirmed correct. A smoke test reveals no vacuum leaks. What should the technician check NEXT?

A. The bank 1 MAF sensing element for contamination causing idle-specific underreading

B. The bank 1 upstream O2 sensor for a lean-biased fault producing false corrections

C. The bank 1 fuel pressure regulator for a fault causing low pressure at idle only

D. The bank 1 exhaust manifold for a leak upstream of the O2 sensor introducing oxygen at idle

3. A returnless fuel system has a P0087 fuel pressure low code. Fuel pressure at idle is 41 psi against a 58–62 psi specification. A fuel volume test at the Schrader valve shows adequate volume. What should the technician check NEXT?

A. The fuel pressure sensor for a calibration fault causing a false low reading despite correct actual pressure

B. The fuel pump for insufficient output — adequate volume does not confirm adequate pressure capability

C. The fuel filter for a restriction reducing rail pressure despite adequate pump volume

D. The fuel injectors for internal leakage bleeding rail pressure below specification

4. A turbocharged engine shows correct boost at light throttle but boost drops 6 psi below specification at WOT. A boost leak test under shop air reveals no leaks. The wastegate actuator moves freely. The compressor wheel is undamaged. What should the technician check NEXT?

A. The intercooler core for an internal restriction reducing charge air volume at WOT

B. The boost pressure sensor for a reading fault affecting WOT boost reporting

C. The wastegate for a stuck-open condition allowing excess exhaust bypass at WOT

D. The turbocharger turbine housing for carbon restriction reducing turbine speed at WOT

5. A vehicle has an exhaust backpressure of 4.2 psi at 2,500 RPM against a 3.0 psi maximum. A backpressure test upstream of the catalytic converter shows 1.1 psi. A backpressure test downstream of the converter shows 4.2 psi. What do these results confirm?

A. The flex pipe between the manifold and converter is the restriction

B. The catalytic converter substrate is the restriction source

C. The muffler downstream of the converter is the restriction

D. Both the converter and muffler contribute equally to the elevated backpressure

6. A GDI engine has a P0087 low fuel pressure code. Low-pressure pump output is confirmed at 58 psi. High-pressure rail pressure at idle is 450 psi against a 500–2,000 psi specification. Under acceleration, rail pressure drops further to 180 psi. The high-pressure pump cam follower stroke is within specification. What is the MOST likely cause?

A. The high-pressure pump pressure relief valve has failed open — it bleeds pressure at the rail

B. The low-pressure pump is under-delivering — 58 psi is below the minimum inlet requirement for the high-pressure pump

C. The high-pressure rail pressure sensor is reading low — actual pressure is within specification

D. The high-pressure pump volume control valve has failed — the pump cannot build or sustain adequate rail pressure despite correct cam follower stroke

7. A port injection engine has rough idle that improves significantly at 2,500 RPM. LTFT is +17% on both banks at idle and +3% at 2,500 RPM. A low-pressure smoke test reveals a small leak at a cracked PCV hose fitting. What is the correct repair and verification?

A. Replace the PCV valve and hose assembly — a cracked fitting confirms the entire PCV system requires replacement

B. Apply silicone to the crack and retest LTFT to confirm the repair before committing to hose replacement

C. Replace the cracked PCV hose, clear LTFT adaptive memory, and verify LTFT normalizes after a drive cycle

D. Replace the upstream O2 sensors in addition to the hose — extended lean operation contaminates the sensors

8. A naturally aspirated engine has LTFT at +3% at idle and +2% at cruise on both banks. During a propane enrichment test near the intake manifold, LTFT moves toward zero and idle quality improves noticeably. A subsequent low-pressure smoke test confirms a small seep at an intake manifold runner gasket. What is the correct interpretation?

A. The propane enrichment response and smoke test together confirm a vacuum leak at the intake manifold runner gasket requiring repair

B. The propane response alone is sufficient to confirm the leak — the smoke test result is redundant

C. The LTFT values are within normal range — the propane response and smoke seep do not require repair at this level

D. The smoke seep at the gasket is below the code threshold — monitoring is appropriate before committing to repair

9. A vehicle has correct fuel pressure at idle. During a WOT acceleration run, pressure drops from 58 psi to 29 psi and does not recover until throttle is released. LTFT is +21% on both banks at all conditions. What does a pressure collapse specifically during WOT that does not recover until throttle is released indicate?

A. A fuel pressure regulator fault — the regulator loses reference vacuum at WOT causing pressure collapse

B. A fuel filter restriction — partial blockage collapses pressure under sustained WOT demand

C. A fuel pump relay fault causing intermittent voltage drop specifically under WOT electrical load

D. A fuel pump that cannot sustain adequate volume under the high-flow demand of WOT — pressure collapses and holds low until demand drops

10. A vehicle has correct exhaust backpressure. LTFT is +2% on both banks. A snap-throttle test produces normal acceleration. The customer reports a sulfur smell from the exhaust under hard acceleration only. No codes are stored. What is the MOST likely cause?

A. A rich mixture under WOT causing incomplete combustion of sulfur compounds in the fuel

B. A catalytic converter that is losing efficiency under the high-temperature demand of hard acceleration — sulfur stored in the catalyst is released when converter temperature exceeds normal operating range

C. A leaking injector delivering excess fuel under WOT conditions producing a sulfur-rich exhaust event

D. An exhaust manifold leak allowing raw exhaust containing sulfur compounds to escape near the cabin under high backpressure at WOT

BONUS SECTION C: ANSWER KEY AND EXPLANATIONS

1. **B. A failed fuel pump check valve allowing complete pressure drain-back to the tank** — Zero psi at the start of cranking confirms complete pressure loss during hot soak — not a partial bleed-down. A failed check valve allows the entire fuel column to drain back to the tank through the pump. A regulator leak or injector leak produces a gradual partial pressure drop, not complete loss. A relay fault would prevent the pump from running at all.
2. **D. The bank 1 exhaust manifold for a leak upstream of the O2 sensor** — Fuel pressure and injector balance are confirmed correct and no vacuum leaks are found — eliminating fuel delivery and unmetered air faults. The idle-specific unilateral lean correction that drops significantly at 2,500 RPM is the pattern of an exhaust manifold leak upstream of the O2 sensor. Low exhaust velocity at idle allows ambient oxygen to enter the exhaust stream through the leak, producing a false lean signal that normalizes at higher RPM as exhaust backpressure increases.
3. **A. The fuel pressure sensor for a calibration fault** — A fuel volume test confirming adequate volume rules out pump delivery capacity as the fault. On a returnless system, if the pump is confirmed moving adequate volume, the next logical question is whether the pressure reading is accurate. A pressure sensor calibration fault causes a false low reading that sets a P0087 without an actual pressure fault being present.
4. **C. The wastegate for a stuck-open condition** — No boost leaks and an undamaged compressor wheel confirm the turbocharger and charge air circuit are intact. A wastegate stuck partially open allows exhaust to bypass the turbine continuously — reducing turbine speed and boost output specifically under the high-flow demand of WOT where the bypass effect is most significant.
5. **B. The catalytic converter substrate is the restriction** — Upstream backpressure at 1.1 psi confirms no restriction between the manifold and the converter inlet. Downstream backpressure at 4.2 psi confirms elevated pressure after the converter. Bracketing the converter with normal upstream and elevated downstream pressure isolates the restriction to the converter substrate itself.
6. **D. The high-pressure pump volume control valve has failed** — Low-pressure supply at 58 psi is confirmed adequate and the cam follower stroke is within specification — confirming the pump's mechanical drive is correct. A volume control valve fault prevents the pump from regulating the quantity of fuel compressed per stroke correctly, producing chronically low rail pressure that collapses further under acceleration demand despite correct mechanical pump function.

7. **C. Replace the cracked PCV hose, clear LTFT adaptive memory, and verify LTFT normalizes** — The low-pressure smoke test directly confirmed the leak source. Replacing the hose eliminates the unmetered air path. Clearing LTFT adaptive memory allows the PCM to relearn correct fuel delivery with the leak corrected. Verifying LTFT returns to within normal range after a drive cycle confirms the repair is complete. Replacing the O2 sensors or applying sealant is not indicated.
8. **A. The propane enrichment response and smoke test together confirm a vacuum leak requiring repair** — The propane response alone is suggestive but not confirmatory — propane near any intake component can diffuse into the airstream without a specific leak. The subsequent low-pressure smoke test directly confirming a seep at the runner gasket provides the physical confirmation needed. Both results together establish the diagnosis and justify repair.
9. **D. A fuel pump that cannot sustain adequate volume under WOT high-flow demand** — Correct idle pressure confirms the pump builds adequate pressure at low demand. Pressure collapsing to 29 psi at WOT and holding low until throttle is released confirms the pump cannot pass the sustained fuel volume required at maximum injector demand — pressure stays collapsed as long as WOT demand exceeds pump delivery capacity. LTFT at +21% bilaterally at all conditions confirms the lean fault extends beyond WOT events.
10. **B. A catalytic converter losing efficiency under hard acceleration** — Correct backpressure, normal LTFT, and no codes rule out a rich mixture, leaking injectors, and exhaust leaks as causes. A converter operating near the end of its efficiency life stores sulfur compounds from the fuel during normal operation. Under hard acceleration, the extreme heat generated by the high-exhaust-flow event exceeds the converter's normal operating temperature, releasing the stored sulfur as hydrogen sulfide — producing the characteristic rotten egg smell specifically during hard acceleration.

BONUS SECTION D: EMISSIONS CONTROL SYSTEMS

10 Questions | Focused Review

1. A PCV valve is removed and held up to a light source — the plunger is visible and moves freely when shaken. With the engine at idle, a finger placed over the inlet feels strong vacuum. The fresh air inlet hose is confirmed clear. What does this indicate?

A. The PCV valve is stuck open and flowing more than specification

B. The PCV valve is stuck closed and must be replaced

C. The PCV system is functioning correctly

D. The fresh air inlet is partially blocked causing excessive vacuum at the PCV port

2. A vehicle fails an emissions test with high HC and high CO at idle. LTFT is -16% on both banks. No codes are stored. What is the MOST likely cause?

A. A rich air-fuel mixture causing incomplete combustion and excess CO and HC

B. A lean misfire delivering unburned HC while elevated combustion temperature raises CO

C. A degraded catalytic converter unable to oxidize HC and CO to acceptable levels

D. Simultaneous upstream O2 sensor contamination causing false rich corrections on both banks

3. A P0446 EVAP vent control circuit code is stored. A bi-directional test commanding the vent solenoid closed produces no change in EVAP system pressure during a subsequent smoke test. The solenoid clicks audibly when commanded. What does an audible click with no pressure change indicate?

A. The vent solenoid is functioning correctly — the click confirms electrical operation and the pressure test confirms sealing

B. The vent solenoid plunger is stuck open — the click confirms electrical activation but the plunger is not moving to seal the vent

C. The EVAP vent hose is disconnected downstream of the solenoid — the solenoid seals but pressure escapes through the open hose

D. The vent solenoid is functioning electrically but not sealing — the coil energizes and clicks but the valve is not closing against the vent port

4. A vehicle has a P0401 insufficient EGR flow code. The EGR valve actuates on bi-directional test. With the valve commanded open at 2,500 RPM, MAP increases only 2 kPa against an 8–12 kPa specification. Carbon cleaning of the EGR passages is performed. After cleaning, MAP increases 9 kPa with the valve commanded open. What does the post-cleaning MAP response confirm?

A. The EGR valve was mechanically faulty and required replacement in addition to the passage cleaning

B. Carbon-restricted EGR passages were preventing adequate exhaust gas flow despite correct valve operation

C. The MAP sensor was reading low before cleaning — the passage cleaning had no effect on actual flow

D. The EGR valve was opening to a reduced position before cleaning — the passages were not the primary fault

5. A vehicle has a P0141 downstream O2 sensor heater fault on bank 1. The heater element measures 9.4 ohms — within specification. Supply voltage at the heater connector is 12.5 volts. The PCM heater control ground reads 0.08 volts referenced to battery negative. What do these results confirm?

A. The heater circuit has a supply voltage fault — 12.5 volts is below the minimum required for the heater to function

B. The PCM heater ground has high resistance — 0.08 volts drop confirms excess resistance preventing current flow

C. The heater circuit is functioning correctly — element resistance, supply voltage, and ground voltage are all within acceptable limits

D. The heater element has an intermittent open — the 9.4-ohm reading reflects a partial continuity path through the damaged element

6. An AIR pump cold start test is performed. The pump runs for 30 seconds. Both upstream O2 sensors show no lean response at any point during the test. Both check valves are confirmed open. The AIR pump runs but produces no audible airflow at the delivery hoses. What should the technician check NEXT?

A. The upstream O2 sensor heaters for premature activation masking the lean response on both banks

B. Both AIR delivery tubes for simultaneous blockage preventing air from reaching the exhaust ports

C. The AIR pump check valves for internal leakage despite confirmed open position

D. The AIR pump output for a seized or failed internal impeller producing motor operation without airflow

7. A vehicle has a P0420 catalyst efficiency code on bank 1. Backpressure downstream of the bank 1 converter is 1.2 psi. The bank 1 downstream O2 sensor is replaced as a first step. After replacement, the P0420 returns within 200 miles. What is the correct interpretation?

A. The catalytic converter has failed — the P0420 returning after downstream sensor replacement confirms the converter as the fault source

B. The new downstream O2 sensor is also faulty — a code returning within 200 miles after sensor replacement confirms a defective replacement part

C. The bank 1 upstream O2 sensor is causing the P0420 — an upstream sensor fault produces false efficiency readings regardless of downstream sensor condition

D. The PCM requires a longer relearn period — 200 miles is insufficient for the catalyst monitor to confirm efficiency after sensor replacement

8. A vehicle has elevated NOx on a tailpipe emissions test. LTFT is +1% on both banks. The EGR valve actuates correctly on a bi-directional test. MAP changes 10 kPa with EGR commanded open at 2,500 RPM. What should the technician check NEXT?

A. The EGR passages for a partial carbon restriction reducing actual flow despite correct valve actuation and MAP response

B. The EGR flow at operating temperature under actual cruise load conditions — a bench actuation test does not confirm flow under real operating conditions

C. The catalytic converter for insufficient NOx reduction capacity — a degraded converter cannot reduce NOx to acceptable levels

D. The EGR valve position sensor for a fault causing incorrect flow reporting despite correct valve movement

9. A vehicle has a P0455 large EVAP leak. The fuel cap seals correctly. A smoke test with the vent solenoid commanded closed reveals no leaks from any hose, canister, or connection. What should the technician check NEXT?

A. Replace the EVAP purge solenoid — a large leak with no smoke test finding confirms the purge solenoid is leaking internally

B. Replace the charcoal canister — a P0455 with no external leak found always indicates a saturated canister body seep

C. Perform the smoke test with the fuel tank at operating temperature — some EVAP components only leak when thermally expanded

D. Inspect the fuel tank itself for a crack or seam leak — large EVAP leaks not found in the hose and canister circuit often originate at the tank

9. P0455 large EVAP leak. Fuel cap seals correctly. Smoke test with vent solenoid commanded closed reveals no leaks anywhere in the system. What should the technician check NEXT?

A. Replace the EVAP purge solenoid — a large leak with no smoke finding confirms internal purge solenoid leakage

B. Replace the charcoal canister — P0455 with no external leak always indicates a canister body seep

C. Perform the smoke test with the fuel tank at operating temperature — some components only leak when thermally expanded

D. Inspect the fuel tank for a crack or seam leak — large leaks not found in the hose and canister circuit often originate at the tank

10. A vehicle has a P0135 upstream O2 sensor heater fault on bank 1. The heater element resistance is 11.8 ohms — within the 8–12 ohm specification. Heater supply voltage is 12.6 volts. The PCM heater control ground reads 10.9 volts referenced to battery negative. What does the 10.9-volt ground reading confirm?

A. The PCM heater ground driver is functioning — 10.9 volts confirms active pull-down on the ground circuit

B. The heater element is at the high end of specification — 11.8 ohms restricts current and causes the voltage drop reading

C. The heater supply circuit has a short to the ground circuit — supply voltage is appearing on the ground wire

D. The PCM heater control ground circuit has excessive resistance — 10.9 volts of drop across the ground path prevents adequate current flow through the heater element

BONUS SECTION D: ANSWER KEY AND EXPLANATIONS

1. **C. The PCV system is functioning correctly** — A freely moving plunger confirms the valve is not stuck. Strong vacuum at the inlet confirms manifold vacuum is reaching the valve and pulling through it correctly. A clear fresh air inlet confirms unrestricted crankcase ventilation airflow. All three elements confirmed correct indicate a fully functional PCV system requiring no action.
2. **A. A rich air-fuel mixture causing incomplete combustion** — Elevated CO and HC together with LTFT at -16% on both banks confirms the PCM is already removing significant fuel in response to a genuine rich condition. CO is the direct product of oxygen-starved rich combustion; elevated HC confirms unburned fuel exiting the exhaust. A lean misfire produces elevated HC but not elevated CO. A degraded converter does not cause negative LTFT.
3. **D. The vent solenoid is functioning electrically but not sealing** — The audible click confirms the solenoid coil is energizing and the plunger is moving. However, no pressure change during the subsequent smoke test confirms the vent port is not being sealed despite plunger movement. A solenoid that clicks but does not seal indicates the plunger is moving but not seating correctly against the valve port — an internal mechanical fault rather than an electrical one.
4. **B. Carbon-restricted EGR passages were preventing adequate exhaust gas flow** — The valve actuated correctly before cleaning, confirming electrical and mechanical valve function was never the fault. The below-specification MAP response before cleaning and within-specification MAP response after cleaning directly confirms the passages were the restriction. The cleaning restored flow to the level the correctly functioning valve was already attempting to deliver.
5. **C. The heater circuit is functioning correctly** — Heater element resistance at 9.4 ohms is within the 8–12 ohm specification. Supply voltage at 12.5 volts is adequate. The PCM heater control ground reading 0.08 volts referenced to battery negative confirms near-zero voltage drop across the ground path — the ground circuit has minimal resistance and current is flowing correctly. All three parameters confirmed normal indicate a functional heater circuit. The stored P0141 should be cleared and monitored for recurrence.
6. **D. The AIR pump output for a seized or failed internal impeller** — Both check valves are confirmed open — eliminating them as the blockage. No audible airflow at the delivery hoses with the pump running confirms the pump motor is operating but producing no air movement. A seized or failed pump impeller produces motor operation and current draw without generating airflow — the motor runs but the impeller cannot move air through the pump housing.

7. **A. The catalytic converter has failed** — Backpressure at 1.2 psi confirms no physical substrate collapse. A P0420 returning within 200 miles after downstream sensor replacement confirms the sensor was not the fault source — a functioning converter would prevent the code from returning regardless of which downstream sensor is installed. The code returning promptly after sensor replacement confirms the converter's oxygen storage capacity is genuinely insufficient.

8. **B. The EGR flow at operating temperature under actual cruise load conditions** — EGR valve actuation and MAP response are confirmed correct on a bi-directional bench test. However, elevated NOx with confirmed correct valve operation and flow response on a static test indicates the EGR system may not be delivering adequate flow under real driving conditions — the temperatures, pressures, and load levels of actual cruise operation differ from a stationary bi-directional test. Confirming EGR function under real operating conditions is the next logical step before condemning other components.

9. **D. Inspect the fuel tank for a crack or seam leak** — The fuel cap seals correctly and a thorough smoke test of the entire accessible EVAP circuit — hoses, canister, solenoids, and connections — reveals nothing. When a large EVAP leak cannot be located in any external component, the fuel tank itself becomes the primary suspect. Tank seam leaks, cracks near the fuel pump module opening, or a damaged filler neck at the tank connection produce large leaks that smoke testing of the external circuit cannot identify without specifically pressurizing and inspecting the tank.

10. **D. The PCM heater control ground circuit has excessive resistance** — Heater element resistance and supply voltage are both confirmed correct. The PCM heater control ground reading 10.9 volts referenced to battery negative means 10.9 volts is being dropped across the ground path resistance before reaching battery negative. A functional ground circuit reads near zero volts. This extreme voltage drop confirms the ground circuit has severe resistance — insufficient current flows through the heater element despite correct supply voltage and a functional element, generating the P0135 heater circuit fault.

BONUS SECTION E: COMPUTERIZED ENGINE CONTROLS INCLUDING OBD II

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10 Questions | Focused Review

1. A vehicle has LTFT at +22% on both banks at idle that drops to +4% at 2,500 RPM. MAF reads correctly on a dynamic test at all airflow rates. Fuel pressure is confirmed correct. A standard smoke test reveals no vacuum leaks. What should the technician perform NEXT?

A. A low-pressure smoke test — an idle-specific bilateral lean condition with confirmed correct MAF and fuel pressure suggests a small leak below standard smoke test detection threshold

B. An injector flow test — bilateral idle-specific lean corrections with correct MAF confirm simultaneous injector restriction

C. An upstream O2 sensor response time test — bilateral idle lean corrections with correct MAF confirm slow sensor response

D. A fuel pump volume test — correct pressure does not confirm adequate volume at idle-specific demand

2. A vehicle has STFT oscillating between +15% and -15% at approximately 2 cycles per second on both banks at idle. LTFT is 0% on both banks. No codes are stored. Idle quality is rough. What is the MOST likely cause?

A. Simultaneous upstream O2 sensor contamination producing bilateral oscillation

B. A MAF sensor fault causing closed-loop hunting

C. A stuck-open EVAP purge solenoid cycling vapor into the intake at idle

D. A vacuum leak at the closed-loop control threshold causing rapid STFT hunting with balanced LTFT

3. A vehicle has a P0172 bank 1 rich code. LTFT bank 1 is -19%. LTFT bank 2 is +2%. All bank 1 injectors pass a balance test. MAF and fuel pressure are confirmed correct. A scope of the bank 1 upstream O2 sensor shows a fixed 0.88 volts without switching under any condition. What does the fixed output confirm?

A. A genuine rich condition on bank 1 — the fixed rich voltage confirms excess fuel delivery the balance test missed

B. An exhaust manifold leak downstream of the sensor introducing exhaust backflow

C. The EVAP purge solenoid is delivering excess vapor preferentially to bank 1

D. The bank 1 upstream O2 sensor element has failed — a fixed output independent of commanded rich and lean events confirms internal element failure

4. A vehicle has all monitors complete with no codes. The customer reports fuel economy 18% below the EPA rating over 4 months with no drivability complaints. STFT and LTFT are within ±4% on both banks. What is the MOST appropriate first step?

A. Perform a compression test — a 4-month gradual efficiency loss suggests developing mechanical wear

B. Review Mode 6 data for parameters approaching fault thresholds without triggering codes

C. Replace the upstream O2 sensors — long-term rich drift causes over-fueling without setting codes

D. Perform a fuel pressure test under load — over-delivery from pressure fault may be masked by trim compensation

5. A vehicle has a U0073 control module communication bus fault stored in multiple modules. The scan tool connects normally and communicates with all modules. All vehicle systems function correctly. No other codes are stored. What is the MOST likely cause?

A. An intermittent CAN bus fault — a resolved interruption stores the code in all modules that detected the loss but leaves no current fault

B. A PCM internal fault preventing correct CAN bus broadcasting during a previous key cycle

C. A scan tool communication fault that falsely stored the code across all modules simultaneously

D. A battery voltage drop during a previous key cycle causing all modules to log a communication fault

6. A vehicle has LTFT at -17% on bank 1 and +3% on bank 2. Injector balance, MAF, and fuel pressure are all confirmed correct on bank 1. The bank 1 upstream O2 sensor switches normally between 0.1 and 0.9 volts. What should the technician check NEXT?

A. The bank 1 upstream O2 sensor for rich-biased contamination — a switching sensor can still be biased

B. The bank 1 fuel pressure regulator for localized over-pressurization

C. An exhaust manifold leak downstream of the bank 1 O2 sensor

D. The EVAP purge solenoid for preferential vapor delivery to bank 1

7. A vehicle has a P0128 code. ECT reads 172°F after 30 minutes of city driving. The thermostat was replaced two weeks ago with the correct OEM part. The cooling fan is confirmed not running continuously. What should the technician check NEXT?

A. The ECT sensor accuracy — a sensor reading low causes P0128 without a thermostat fault

B. The coolant mixture for an incorrect antifreeze ratio affecting thermostat opening temperature

C. The thermostat housing for a bypass leak allowing coolant to circulate around the thermostat

D. The water pump for reduced flow preventing the coolant from reaching regulation temperature

8. A vehicle has STFT at +2% and LTFT at +3% on both banks throughout all driving. At highway cruise, LTFT drops bilaterally to -6% for approximately 90 seconds then returns to baseline. The EVAP purge solenoid is confirmed commanded open during the drop. What is the correct interpretation?

A. The charcoal canister is saturated — a -6% bilateral drop confirms excess vapor delivery

B. Normal EVAP purge operation — commanded vapor delivery causes the temporary negative trim correction

C. A fuel pressure increase at highway speed causes the bilateral trim drop during the purge window

D. A stuck-open purge solenoid — the trim drop confirms it was open before the command was issued

9. A vehicle has a P0300 random misfire. All monitors are complete. Fuel trims are within ±3%. Compression, leakage, and ignition waveforms are confirmed normal. A cylinder contribution test at idle shows all cylinders within 12 RPM. Mode 6 data shows the cylinder 4 misfire counter at 91% of the maximum allowed threshold. What is the MOST appropriate next step?

A. No action — the P0300 is random and no specific cylinder misfire code has confirmed

B. Replace the catalytic converter — elevated Mode 6 misfire counts indicate HC damage is occurring

C. Perform a contribution test at 2,500 RPM under load — the idle test did not reveal the cylinder 4 fault

D. Inspect cylinder 4 ignition, injector, and compression with more sensitive testing before a P0304 sets

9. P0300 random misfire. All systems confirmed normal at idle. Mode 6 shows cylinder 4 misfire counter at 91% of maximum threshold. What is the MOST appropriate next step?

A. No action — no cylinder-specific code has confirmed

B. Replace the catalytic converter — elevated misfire counts indicate HC damage

C. Perform a contribution test at 2,500 RPM — the idle test did not reveal the fault

D. Inspect cylinder 4 ignition, injector, and compression with more sensitive testing before P0304 sets

10. A vehicle has LTFT at +3% and +2% on both banks at all driving conditions. No codes are stored. All monitors are complete. A bi-directional EVAP purge test causes both banks' LTFT to drop to -4% within 60 seconds and return to baseline when purge is commanded off. What does this confirm?

A. The EVAP purge solenoid opens and closes correctly and the canister has stored vapor available for delivery

B. The charcoal canister is saturated — a -4% bilateral drop confirms excess vapor delivery from an overloaded canister

C. The purge solenoid was already open before the command — the LTFT drop confirms a stuck-open condition

D. The fuel pressure rises during the purge event — the LTFT drop reflects pressure-driven over-delivery rather than vapor contribution

BONUS SECTION E: ANSWER KEY AND EXPLANATIONS

1. **A. A low-pressure smoke test** — Correct MAF, correct fuel pressure, and no standard smoke test leaks eliminate the most common bilateral lean causes. An idle-specific bilateral lean correction that normalizes at 2,500 RPM is the classic pattern of a small vacuum leak — its lean effect is significant at idle airflow but becomes a smaller fraction of total airflow at higher RPM. A low-pressure smoke machine detects pinhole leaks and seeps that standard testing cannot.
2. **C. A stuck-open EVAP purge solenoid cycling vapor into the intake at idle** — STFT oscillating rapidly with LTFT at zero confirms the average mixture is near stoichiometric but short-term control is continuously hunting. A partially stuck purge solenoid delivers intermittent vapor bursts — the closed-loop system alternately corrects rich when vapor arrives and lean when it stops, producing the rapid oscillation. Unlike a vacuum leak, a vapor delivery fault keeps LTFT near zero while producing periodic STFT swings.
3. **D. The bank 1 upstream O2 sensor element has failed** — All bank 1 delivery components are confirmed correct and bank 2 is near zero, eliminating shared faults. A sensor reading a fixed 0.88 volts without switching under any condition — including during commanded lean events that should drive output below 0.2 volts — confirms the element is outputting a fixed rich-biased voltage independent of actual exhaust composition. The PCM interprets this as a persistent rich condition and removes fuel accordingly.
4. **B. Review Mode 6 data for parameters approaching fault thresholds** — All monitors are complete with no codes and normal fuel trims, ruling out obvious current faults. An 18% fuel economy reduction over 4 months without drivability symptoms or codes suggests a fault developing within the PCM's trim compensation range. Mode 6 data may identify specific parameters approaching fault thresholds before they confirm — directing diagnosis efficiently without committing to invasive testing.
5. **A. An intermittent CAN bus fault that has since resolved** — All modules communicate correctly with the scan tool and all systems function normally. A U0073 stored across multiple modules with no current fault confirms the bus interruption occurred during a previous key cycle and has since recovered. A resolved intermittent connection fault, corroded ground, or momentary voltage drop stores the code in every module that detected the loss without leaving a traceable current fault.
6. **D. The EVAP purge solenoid for preferential vapor delivery to bank 1** — All bank 1 delivery components are confirmed correct and the O2 sensor is switching accurately — confirming the

rich condition is real and the sensor is reporting it correctly. With no injection or pressure fault identified, the unmetered fuel source must originate outside the normal injection system. An EVAP purge solenoid or manifold configuration delivering disproportionate vapor to bank 1 introduces unmetered fuel causing the unilateral rich correction.

7. **C. The thermostat housing for a bypass leak** — The correct OEM thermostat was installed two weeks ago, making a second immediate thermostat failure unlikely. The cooling fan is confirmed not running continuously. A bypass leak in the thermostat housing allows coolant to circulate around the thermostat rather than through it — continuously cycling through the radiator regardless of engine temperature and preventing the coolant from reaching the PCM's regulation threshold even with a correctly functioning thermostat.
8. **B. Normal EVAP purge operation** — Base LTFT within normal range confirms no underlying fuel fault. The scan tool directly confirms the purge solenoid was commanded open during the LTFT drop — establishing a confirmed causal relationship. Canister vapor delivered through the open solenoid adds unmetered fuel to both banks, causing the bilateral negative trim correction. LTFT returning to baseline when purge is commanded off confirms the solenoid closes correctly and vapor delivery stops.
9. **D. Inspect cylinder 4 ignition, injector, and compression with more sensitive testing** — All systems are confirmed normal under idle test conditions. Mode 6 showing cylinder 4 at 91% of the maximum misfire threshold confirms cylinder 4 is the specific cylinder accumulating misfires — approaching the P0304 confirmation limit. Acting on the Mode 6 finding before the code confirms allows the fault to be identified and corrected before catalyst damage occurs from continued misfire events.
10. **A. The EVAP purge solenoid opens and closes correctly and the canister has stored vapor** — Base LTFT within normal range confirms no underlying fuel fault. The controlled bilateral LTFT drop during commanded purge and recovery when commanded off confirms the solenoid opens when commanded, the canister has stored vapor available for delivery, and the solenoid closes correctly when the command ends. A saturated canister would produce a much larger trim drop; a stuck-open solenoid would show trim deviation before the command is issued.