

PRACTICE EXAM 13: ASE A8 ENGINE PERFORMANCE FULL-LENGTH SIMULATION

50 Questions | 75 Minutes

DOMAIN A — GENERAL DIAGNOSIS (Questions 1–12)

1. A vacuum gauge at idle shows a reading of 15 in/Hg with a needle that drops sharply and regularly at a rate of once every two seconds. What does this MOST likely indicate?

- A. A large vacuum leak causing periodic disruption of manifold vacuum
- B. A single cylinder misfiring on every power stroke at the idle RPM
- C. A sticking EGR valve opening and closing in response to manifold vacuum pulses
- D. Retarded ignition timing causing a periodic vacuum drop at a fixed interval

2. A compression test on a V6 engine shows cylinders 1, 2, and 3 between 160 and 170 psi. Cylinders 4, 5, and 6 all read between 85 and 95 psi. A wet test on the low cylinders shows no improvement. What is the MOST likely cause?

- A. Worn piston rings on all three cylinders on one bank simultaneously
- B. A PCV system fault causing oil flooding of the low bank cylinders
- C. A severely retarded camshaft on the low bank limiting compression development
- D. A blown head gasket or failed cylinder head on the low bank affecting all cylinders on that side

3. An engine has a light knock that is present only when the engine is under load and disappears completely at idle and during deceleration. The knock is more pronounced when the engine is warm. What is the MOST likely cause?

- A. Piston slap from excessive bore clearance that is most pronounced under cylinder pressure
- B. A loose harmonic balancer producing a load-sensitive knock at the front of the engine
- C. Detonation or spark knock from excessive ignition advance or low-octane fuel under load
- D. Worn connecting rod bearings producing a knock only under the high pressure of combustion

4. A cylinder leakage test on cylinder 5 shows 62% leakage with air escaping from the oil filler cap and coolant visible bubbling in the radiator simultaneously. What does this indicate?

- A. Both the piston rings and head gasket on cylinder 5 have failed simultaneously
- B. Only the head gasket has failed — air escaping from the oil filler is a secondary path through the block
- C. The piston on cylinder 5 has cracked, creating multiple leak paths simultaneously
- D. A severely burned exhaust valve is allowing combustion gases to exit through multiple paths

5. An engine produces heavy blue smoke continuously at all operating conditions. A cylinder leakage test shows 5% leakage on all cylinders. What is the MOST likely cause?

- A. Severely worn piston rings allowing oil consumption at all conditions despite low leakage numbers
- B. A stuck-open PCV valve allowing oil mist to enter the intake at a high rate under all conditions
- C. A failed turbocharger seal delivering oil into the intake under all boost conditions
- D. Worn valve stem seals allowing oil to be drawn past all valves continuously despite normal ring seal

5. An engine has heavy blue smoke at all conditions. Cylinder leakage is 5% on all cylinders. What is the MOST likely cause?

- A. Worn piston rings despite low leakage numbers
- B. A stuck-open PCV valve allowing high-rate oil mist entry under all conditions
- C. A failed turbocharger seal delivering oil to the intake under all boost conditions

D. Worn valve stem seals allowing continuous oil entry despite normal ring seal

6. A cooling system pressure test holds steady at 16 psi for 5 minutes then drops to 13 psi over the next 10 minutes. No external leak is visible. Coolant level is slightly low. What should the technician check NEXT?

A. The water pump weep hole for seepage below the detection threshold of the visual inspection

B. The head gasket for an internal leak allowing pressurized coolant to enter the combustion chamber or oil passages

C. The radiator end tanks for hairline cracks that only leak under the applied test pressure

D. The heater core for a slow internal leak that is not visible in the passenger compartment

7. A relative compression test is performed. All cylinders crank at similar speed and amperage. When the technician checks the data, cylinder 2 shows a normal crank speed but zero amperage contribution. What does this MOST likely indicate?

A. The fuel injector on cylinder 2 activated during the test affecting the current measurement

B. The CKP sensor signal produces a dropout near cylinder 2 affecting the speed measurement

C. A fault in the current sensor or test equipment connection affecting the cylinder 2 reading only

D. Cylinder 2 has no compression and is contributing no resistance to the starter on its compression stroke

8. An engine has a hot-start misfire that occurs only after the vehicle has been parked for 30–45 minutes following a long drive — a classic hot soak condition. The misfire clears within 15 seconds of running. What should the technician check FIRST?

A. The spark plugs for heat range mismatch causing fouling during the hot soak period

B. The upstream O₂ sensors for slow response after heat soak causing delayed closed-loop entry

C. The fuel injectors for external leakage past O-rings flooding cylinders during the hot soak period

D. The idle air control system for a fault causing insufficient airflow during the hot soak restart

8. An engine has a hot-soak misfire that appears after 30–45 minutes of parking following a long drive and clears within 15 seconds. What should the technician check FIRST?

- A. Spark plugs for heat range mismatch causing hot soak fouling
- B. Upstream O2 sensors for slow response after heat soak
- C. Fuel injectors for external O-ring leakage flooding cylinders during the hot soak period
- D. The idle air control system for insufficient airflow on hot soak restart

9. An engine has a misfire that occurs only above 60 mph under light cruise throttle. Below 60 mph and at WOT the engine runs normally. Compression is normal. What is the MOST likely cause?

- A. A spark plug with a slightly wide gap that misfires under the specific load and vacuum conditions of light-throttle highway cruise
- B. A partially blocked fuel injector that causes lean misfire only under sustained moderate fuel demand at cruise
- C. An EGR valve stuck open that only affects combustion at the specific vacuum level present at light-throttle cruise
- D. A MAF sensor fault that only produces incorrect readings in the specific airflow range of 60 mph cruise

10. An engine has a rattle from the front of the engine that is present immediately on cold start and disappears after 5–10 seconds. Oil level and pressure are confirmed normal. What is the MOST likely cause?

- A. A loose harmonic balancer that tightens with thermal expansion within seconds of startup
- B. A hydraulic timing chain tensioner that has bled down during shutdown and requires oil pressure to recover
- C. Piston slap from cold bore clearance that resolves as the pistons reach operating temperature
- D. Valve lifters that bleed down during shutdown and require oil pressure to recover from lash

11. A vacuum test is performed with the engine at operating temperature. The needle reads 18 in/Hg at idle. When idle RPM is increased to 2,000 and held for 10 seconds, the needle gradually drops from 20 in/Hg to 8 in/Hg over that period. What does this indicate?

- A. A large vacuum leak that becomes significant only at sustained higher RPM
- B. Retarded ignition timing causing progressive vacuum loss under sustained RPM
- C. Exhaust restriction that cannot sustain the higher exhaust flow and progressively collapses vacuum
- D. Worn piston rings that lose their seal under sustained elevated cylinder pressure

12. A no-start condition exists on a vehicle with a sequential port injection system. Spark is confirmed on all cylinders. Fuel pressure is 58 psi. A scan tool shows no CMP sensor signal during cranking but the CKP sensor signal is normal. What will MOST likely result from the absent CMP signal?

- A. The PCM defaults to a batch-fire injection strategy and the engine may start despite the absent CMP signal
- B. The PCM disables all spark output as the CMP signal is required for ignition triggering on this system
- C. The PCM commands maximum fuel enrichment to compensate for the missing timing reference
- D. The PCM completely shuts down and loses communication with the scan tool during cranking

DOMAIN B — IGNITION SYSTEM DIAGNOSIS AND REPAIR (Questions 13–20)

13. A spark plug removed from a cylinder shows a wet, oily black deposit covering the insulator and electrode. The electrode shows minimal wear. What does this indicate?

- A. Carbon fouling from rich combustion or excessive idling
- B. Normal wear deposits on a plug that has reached its service interval
- C. Pre-ignition damage causing oil to be drawn into the combustion chamber
- D. Oil fouling from worn valve stem seals or piston rings allowing oil into the combustion chamber

14. A COP system has a P0352 ignition coil B fault code. The technician measures coil B primary resistance at 0.4 ohms against a specification of 0.5–1.5 ohms. What does this indicate?

- A. The coil primary is open — 0.4 ohms is below the minimum specification
- B. The coil primary winding may be shorted — 0.4 ohms is below the minimum specification and suggests internal shorting
- C. The coil primary resistance is within specification — 0.4 ohms is acceptable for this system
- D. The coil primary resistance measurement is being affected by the PCM driver circuit holding the reading low

15. A secondary ignition scope waveform shows all cylinders with normal firing lines and spark lines. One cylinder shows a spark line duration that is twice as long as all other cylinders. What does a longer-than-normal spark line duration on one cylinder MOST likely indicate?

- A. A weak coil on that cylinder extending the arc duration to compensate for reduced energy output
- B. A high-resistance secondary circuit on that cylinder reducing current flow and prolonging the arc
- C. A spark plug with a narrower-than-normal gap on that cylinder sustaining the arc longer at lower current
- D. Normal variation — spark line duration varies significantly between cylinders based on combustion conditions

16. A Hall effect CMP sensor is tested with a lab scope during engine cranking. The waveform shows the signal switching correctly between 0 and 5 volts but the signal drops out completely for approximately 0.2 seconds once per camshaft revolution. What is the MOST likely cause?

- A. A chipped, missing, or damaged reluctor tooth on the camshaft trigger wheel at that position
- B. A PCM input circuit fault causing periodic rejection of the CMP signal at that specific crank position
- C. A wiring intermittent that coincides with the camshaft reaching a specific rotational position
- D. Normal behavior — a brief dropout once per revolution is the designed reference gap on most CMP systems

17. A waste spark ignition system has a misfire on cylinder 1. The coil serving cylinders 1 and 6 is confirmed good by swap testing. The plug wire on cylinder 1 is swapped with the cylinder 6 wire. The misfire moves to cylinder 6. What does this confirm?

- A. The cylinder 1 spark plug has failed and requires replacement
- B. The PCM driver circuit for the cylinder 1 and 6 coil position has a fault
- C. Both the cylinder 1 plug wire and spark plug should be replaced before confirming the diagnosis
- D. The cylinder 1 plug wire has high resistance and is the cause of the misfire

17. On a waste spark system, the coil serving cylinders 1 and 6 is confirmed good by swap. The cylinder 1 plug wire is swapped with the cylinder 6 wire and the misfire moves to cylinder 6. What does this confirm?

- A. The cylinder 1 spark plug has failed
- B. The PCM driver circuit for the cylinder 1 and 6 coil has a fault
- C. Both the plug wire and spark plug on cylinder 1 should be replaced
- D. The cylinder 1 plug wire has high resistance and is the cause of the misfire

18. A magnetic reluctance CKP sensor waveform shows a normal pattern at all speeds but an intermittent large voltage spike — significantly above normal tooth amplitude — appears randomly between tooth signals. What is the MOST likely cause?

- A. A PCM input circuit fault randomly injecting a voltage spike into the CKP signal processing circuit
- B. Electromagnetic interference from an adjacent ignition or accessory circuit inducing a voltage spike on the CKP wiring
- C. A cracked reluctor wheel tooth that intermittently contacts the sensor tip during rotation
- D. Normal behavior — random amplitude spikes between teeth are a characteristic of magnetic reluctance sensors at high RPM

19. A COP system has confirmed misfires on cylinders 2, 4, and 6 on a V6 engine. All three cylinders are on the same bank. Coil, plug, and injector swaps confirm no individual component fault. What should the technician check NEXT?

- A. A bank-specific vacuum leak affecting only the even-numbered cylinders on that bank
- B. The PCM for an internal fault disabling the firing commands for that specific cylinder group
- C. A shared power supply or ground circuit for the bank 2 coils for an open or high-resistance fault
- D. The compression and leakage on all three cylinders simultaneously for a common head or gasket fault

20. A technician removes a spark plug and finds the ground electrode has been completely worn away — only the center electrode remains, worn to a nub. What is the MOST likely cause?

- A. Pre-ignition from incorrect heat range causing the ground electrode to erode thermally
- B. Normal wear from a plug that has significantly exceeded its recommended replacement interval
- C. Detonation from low-octane fuel causing repeated mechanical erosion of the ground electrode
- D. Excessive secondary voltage from a high-output aftermarket coil causing accelerated electrode erosion

DOMAIN C — FUEL, AIR INDUCTION, AND EXHAUST SYSTEMS (Questions 21–30)

21. A returnless fuel system shows 62 psi at key-on. After 20 minutes with the key off, pressure has dropped to 58 psi. After 8 hours overnight, pressure has dropped to 14 psi. What is the MOST likely cause?

- A. A stuck-open fuel pressure regulator bleeding pressure slowly through the return circuit
- B. A slow vacuum leak at the intake manifold allowing fuel pressure to bleed through injector O-rings
- C. Normal pressure decay — returnless systems always lose pressure overnight from thermal contraction
- D. A failed pump check valve or slow injector leakage allowing fuel to drain back to the tank overnight

22. A scan tool on a MAF-equipped vehicle shows LTFT at -21% at idle that recovers to +1% at 2,500 RPM. The MAF reads 8.9 g/s at idle against a 4.0–5.5 g/s specification. What is the MOST likely cause?

- A. A vacuum leak downstream of the MAF causing unmetered air entry and negative fuel trims at idle
- B. A MAF sensor reading significantly above actual airflow specifically at idle, causing the PCM to over-deliver fuel
- C. A stuck-open EVAP purge solenoid adding excess vapor predominantly at idle and not at cruise
- D. A fuel pressure regulator stuck at high pressure delivering excess fuel predominantly at idle

23. A port injection engine has a P0087 fuel rail pressure low code. Fuel pressure is 28 psi at idle against a 58 psi specification. When the return line is briefly pinched, pressure rises immediately to 58 psi. What does this confirm?

- A. The fuel pressure regulator is stuck open and allowing excessive fuel return, dropping rail pressure below specification
- B. The fuel pump is delivering insufficient volume to maintain idle pressure requirements
- C. The fuel filter is restricted, limiting pump output to the rail under normal flow conditions
- D. A leaking fuel injector is bleeding rail pressure down through an open injector internal circuit

24. A scan tool shows ECT reading 248°F on a vehicle with a specified operating range of 190–215°F. The cooling fan is running at high speed. No overheating warning light is illuminated. Coolant level is correct. What should the technician check FIRST?

- A. The water pump for a broken impeller causing inadequate coolant circulation at operating temperature
- B. The radiator for blockage reducing the cooling capacity under normal operating conditions
- C. The ECT sensor and its circuit for a fault producing an elevated reading before condemning cooling components
- D. The thermostat for a stuck-closed condition preventing coolant circulation and causing genuine overheating

25. A GDI engine has a P0300 random misfire and carbon buildup confirmed on the intake valves via borescope. Compression and ignition are confirmed normal. The high-pressure rail reads correct pressure. What is the MOST likely cause of the misfires?

- A. The carbon deposits on the intake valves are restricting airflow to cylinders causing lean misfires
- B. A high-pressure injector is leaking and flooding affected cylinders with excess fuel causing rich misfires
- C. A low-pressure pump fault is causing inconsistent fuel delivery to the high-pressure pump under demand
- D. The carbon deposits are causing intake valve sealing issues leading to compression leaks on affected cylinders

26. A naturally aspirated engine has LTFT at +22% on bank 1 and +3% on bank 2 at idle and at cruise. No codes are stored. A smoke test reveals a small leak at a cracked vacuum hose near the bank 1 intake manifold. What is the MOST appropriate next step?

- A. Replace the vacuum hose and intake manifold gasket simultaneously as both are likely contributing to the bank 1 lean condition
- B. Replace the cracked vacuum hose and retest LTFT after a sufficient drive cycle to confirm the repair
- C. Test the bank 1 upstream O₂ sensor before repairing the vacuum hose to confirm sensor accuracy
- D. Replace the bank 1 fuel injectors for restriction as a contributing factor to the lean condition

27. A turbocharged engine has boost that builds normally to 12 psi at 3,000 RPM but never exceeds 12 psi at any RPM despite the wastegate solenoid being commanded to hold the wastegate closed at higher boost targets. What should the technician check?

- A. The wastegate solenoid for a fault preventing PCM command from reaching the wastegate actuator
- B. The boost pressure sensor for a calibration fault causing the PCM to misread actual boost at all RPM
- C. The wastegate actuator for a mechanical fault — stuck open or weakened diaphragm — preventing closure beyond the spring pressure limit
- D. The intercooler for a developing internal restriction limiting charge pressure under high-flow conditions

28. A fuel pressure test on a port injection engine shows correct idle pressure. Under a snap-throttle test, pressure drops 12 psi momentarily before recovering to specification within 2 seconds. What is the MOST likely interpretation?

- A. This is normal behavior — a brief pressure drop during a snap-throttle demand event is expected and acceptable
- B. A partially clogged fuel filter causing momentary pressure loss under the sudden high-demand snap-throttle event
- C. A failing fuel pump that cannot respond to sudden high-demand events despite maintaining adequate idle pressure
- D. A fuel pressure regulator that is slow to respond to sudden demand changes causing a momentary pressure drop

29. An engine has a P0172 rich code on both banks. LTFT is -17% on both banks at all engine speeds. Fuel pressure is 60 psi against a 55–65 psi specification. Injector balance test shows all injectors within 3% of each other. What should the technician check NEXT?

- A. The MAF sensor for contamination causing a high airflow reading that results in rich fuel delivery
- B. An upstream O2 sensor on each bank for simultaneous contamination biasing both toward a rich signal
- C. The EVAP purge solenoid for a stuck-open condition adding excess fuel vapor to the intake on both banks
- D. A vacuum leak downstream of the MAF introducing unmetered air and triggering false negative trims

29. P0172 rich on both banks. LTFT is -17% on both banks at all engine speeds. Fuel pressure is within spec. Injector balance shows all injectors within 3% of each other. What should the technician check NEXT?

- A. The MAF sensor for contamination causing a high airflow reading
- B. Both upstream O2 sensors for simultaneous contamination biasing both toward rich
- C. The EVAP purge solenoid for a stuck-open condition adding excess vapor to both banks
- D. A vacuum leak downstream of the MAF introducing unmetered air

30. A vehicle has low power under load with correct idle performance. An exhaust backpressure test at 2,500 RPM shows 4.8 psi against a 3.0 psi maximum specification. No codes are stored. What is the MOST likely cause?

- A. A partially clogged catalytic converter substrate restricting exhaust flow under increased demand
- B. A restricted exhaust pipe from an impact or collapse reducing flow cross-section under load
- C. A failing EGR valve stuck open adding exhaust gas to the intake and reducing power under load
- D. A secondary AIR pump running continuously and increasing exhaust backpressure under all conditions

DOMAIN D — EMISSIONS CONTROL SYSTEMS (Questions 31–37)

31. A PCV system is inspected. The PCV fresh air inlet hose is confirmed unobstructed. The PCV valve rattles freely. When the PCV hose is disconnected from the intake manifold, a very weak vacuum is felt at the manifold port. What does the weak vacuum indicate?

- A. The intake manifold PCV port has a carbon restriction limiting vacuum flow to the PCV circuit
- B. A stuck-open PCV valve bleeding vacuum through the system and reducing available manifold vacuum
- C. The PCV valve is undersized for this engine and insufficient vacuum is a design characteristic
- D. Normal PCV vacuum — manifold vacuum at the PCV port is always lower than brake booster vacuum

32. A vehicle has a P0300 random misfire and elevated NO_x on an emissions test. EGR operation is confirmed. LTFT is -2% on both banks. No ignition codes are stored. What is the MOST likely cause?

- A. A lean air-fuel mixture causing random lean misfires and simultaneously elevating combustion temperatures for NO_x
- B. An ignition misfire delivering unburned fuel to the exhaust — the elevated NO_x is from catalyst overheating from the HC load
- C. A rich air-fuel mixture causing random misfires while negative trims confirm excess fuel is reaching the exhaust

D. A stuck-open EGR valve causing random misfires from exhaust dilution while reducing NO_x below the test threshold

33. A P0446 EVAP vent circuit code is stored. The vent solenoid is commanded open during a bi-directional test. The fuel tank pressure sensor reading drops from +0.5 in/Hg to 0.0 in/Hg when commanded. What does the fuel tank pressure change confirm?

A. The vent solenoid is stuck partially open and is only venting to atmospheric pressure when commanded

B. The vent solenoid is opening correctly and allowing the tank pressure to equalize to atmospheric

C. The EVAP system has a downstream restriction preventing full equalization to atmospheric pressure

D. The fuel tank pressure sensor is out of calibration and requires replacement before EVAP diagnosis continues

34. A vehicle has elevated HC at idle on a tailpipe test. A scan tool shows a P0301 cylinder 1 misfire code and LTFT of +1% on both banks. What should the technician check to identify the cause of the cylinder 1 misfire?

A. The fuel injector on cylinder 1 for lean delivery causing the idle misfire and elevated HC

B. The upstream O₂ sensor on the cylinder 1 bank for contamination causing lean overcorrection

C. The ignition components on cylinder 1 — coil, plug, and wire — for a fault causing the misfire and HC delivery

D. The compression on cylinder 1 for a mechanical fault causing both the misfire and the elevated HC

35. A secondary AIR system pump is confirmed running during cold start. The upstream O₂ sensor on bank 1 shows a strong lean response. The upstream O₂ sensor on bank 2 shows no lean response. What should the technician inspect NEXT?

A. The AIR distribution system for a fault — blocked tube, failed check valve, or disconnected hose — on the bank 2 side

B. The bank 2 upstream O₂ sensor for a fault preventing it from responding to the confirmed air delivery

- C. The AIR pump for insufficient output on the bank 2 side of its internal impeller
- D. The bank 2 exhaust manifold for a leak that is diluting the AIR effect before it reaches the O2 sensor

36. A vehicle has a P0457 EVAP system large leak detected — loose or missing fuel cap code. The fuel cap is confirmed correctly installed and seals correctly on a pressure test. A smoke test immediately reveals smoke exiting a cracked EVAP vapor line at the rear of the vehicle near the fuel tank. What is the MOST likely reason the code specifically named the fuel cap?

- A. The OBD II system always defaults to naming the fuel cap in a P0457 code regardless of the actual leak location
- B. The OBD II system detected a large EVAP leak and the PCM identified the fuel cap as the most probable cause before the smoke test confirmed the actual location
- C. The vapor line leak was secondary to a fuel cap that was loose previously — the cap code is a historic artifact
- D. A P0457 code is only set when the fuel cap is actually loose — a vapor line crack would generate a P0455 or P0456

37. A vehicle has a P0138 downstream O2 sensor high voltage code on bank 1. The downstream sensor reads between 0.75 and 0.85 volts and does not switch. The upstream sensor is switching normally. LTFT on bank 1 is -3%. What is the MOST likely cause?

- A. A rich air-fuel mixture on bank 1 causing the downstream sensor to read in the rich voltage range continuously
- B. A catalytic converter that has failed on bank 1 — the downstream sensor reflects the same rich exhaust passing through an ineffective catalyst
- C. A downstream O2 sensor contaminated or failed with its element biased toward the rich voltage range
- D. A head gasket leak on bank 1 introducing combustion gases into the exhaust causing the downstream sensor to read rich

DOMAIN E — COMPUTERIZED ENGINE CONTROLS INCLUDING OBD II (Questions 38–50)

38. A scan tool shows STFT at +3% and LTFT at +2% at idle on both banks. At 2,500 RPM, STFT is +2% and LTFT is +3% on both banks. No codes are stored. What is the correct interpretation?

- A. A small vacuum leak is causing bilateral positive trims at all engine speeds requiring further investigation
- B. A MAF sensor reading slightly low is causing mild positive trims that are consistent across RPM ranges
- C. Fuel trims are within the normal operating range — no fault is indicated and no action is required
- D. The positive LTFT at all speeds confirms a fuel delivery fault that should be diagnosed before the next emissions test

39. A P0171 lean code on bank 1 is stored. LTFT bank 1 is +23% and bank 2 is +2%. The technician applies propane near the bank 1 throttle body base. Idle quality improves and LTFT begins moving toward zero. What does this confirm?

- A. A vacuum leak at or near the bank 1 throttle body base is the cause of the bank 1 lean condition
- B. The bank 1 upstream O₂ sensor is contaminated and responding falsely to the propane enrichment
- C. The bank 1 fuel injectors are restricted — propane enrichment compensates for the lean delivery
- D. The throttle body gasket on bank 1 should be replaced along with the bank 1 upstream O₂ sensor

40. A scan tool captures a deceleration event. During deceleration fuel cutoff, STFT shows +22% and the upstream O₂ sensor reads a fixed 0.1 volts. The moment the throttle reopens, STFT immediately returns to +1% and the O₂ sensor resumes normal switching. What is the correct interpretation?

- A. An intermittent injector fault is causing a lean event during the deceleration period before recovering at throttle reopening
- B. A PCM fault is causing STFT to spike erroneously during deceleration fuel cutoff events

C. A vacuum leak that only activates during the high-vacuum deceleration condition causes the lean reading

D. This is normal PCM behavior — during deceleration fuel cutoff, fuel delivery stops and the O2 sensor reads lean while STFT climbs in preparation for fuel resumption

41. A vehicle has a P0172 rich code on bank 1 only. LTFT bank 1 is -20%. LTFT bank 2 is +1%. A bi-directional injector disable test on all bank 1 injectors simultaneously causes LTFT bank 1 to move toward zero within 15 seconds. What does this confirm?

A. The MAF sensor is reading high on the bank 1 airflow side causing a bank-specific rich condition

B. A bank 1 exhaust manifold leak is introducing oxygen that was masking the true bank 1 fuel delivery fault

C. One or more bank 1 fuel injectors are leaking and contributing excess fuel to the bank 1 rich condition

D. The bank 1 upstream O2 sensor is contaminated and providing a false rich signal to the PCM

42. A scan tool shows all OBD II monitors complete on a vehicle presented for a smog inspection pre-check. Mode 1 data shows LTFT at +2% on both banks. The technician confirms no codes are stored. What should the technician advise?

A. The vehicle appears ready for emissions inspection — monitors are complete, trims are normal, and no codes are stored

B. The LTFT values should be rechecked after a hot restart before confirming readiness for inspection

C. The vehicle requires a full drive cycle rerun to confirm all monitors are stable before the inspection

D. A propane enrichment test should be performed to confirm no vacuum leaks before emissions inspection

43. A vehicle has a P0601 PCM memory checksum error code stored. The vehicle was recently involved in a minor front-end collision. All other systems test normally. What should the technician check FIRST?

A. The PCM connector and grounds for damage from the collision before condemning the PCM

- B. The CAN bus wiring for collision damage causing communication errors that generate the P0601
- C. The battery for a low charge condition from the collision causing the PCM memory error
- D. The PCM for physical damage from the collision — a P0601 internal memory code requires PCM replacement

43. A P0601 PCM memory checksum error is stored after a minor front-end collision. All other systems test normally. What should the technician check FIRST?

- A. The PCM connector and grounds for collision damage before condemning the PCM
- B. The CAN bus wiring for collision damage generating the P0601
- C. The battery for a low charge condition from the collision
- D. The PCM for physical damage — a P0601 always requires replacement

44. A vehicle has a P0300 random misfire that is worse during light throttle cruise and improves at WOT. LTFT is +18% on both banks at idle that drops to +4% at cruise. What is the MOST likely cause?

- A. An ignition system fault that worsens under the specific load and vacuum conditions of light-throttle cruise
- B. A vacuum leak causing a lean condition at idle that is most severe during light-throttle cruise vacuum conditions
- C. A MAF sensor fault that produces incorrect readings specifically in the light-throttle cruise airflow range
- D. Worn fuel injectors delivering insufficient fuel under the specific pulse width demands of light-throttle cruise

45. A vehicle fails an OBD II emissions inspection due to a stored P0420 catalyst efficiency code. The technician replaces the catalytic converter. After replacement, the downstream O2 sensor still switches at the same rate as the upstream sensor. What should the technician check BEFORE concluding the new converter has also failed?

- A. The upstream O₂ sensor for contamination or slow response that prevents accurate catalyst efficiency evaluation after the repair
- B. A rich condition from a fuel delivery fault that is contaminating and degrading the new converter rapidly
- C. A downstream O₂ sensor with a fault producing a false rapid-switching pattern independent of catalyst function
- D. A PCM calibration fault preventing the catalyst monitor from recognizing the improved converter efficiency

46. A vehicle has STFT at +19% and LTFT at +21% on both banks at idle. At 2,500 RPM both STFTs drop to +2% and LTFTs begin recovering toward +4%. No vacuum leak is found on smoke testing. The MAF sensor reads 4.8 g/s at idle — within specification. What should the technician check NEXT?

- A. The fuel pressure under idle conditions for a drop that is not detectable at higher RPM
- B. The EVAP purge solenoid for a stuck-closed fault preventing canister purging and causing accumulation
- C. The MAF sensor for a contamination fault that underreads predominantly at the low-airflow idle range despite passing a static voltage check
- D. The upstream O₂ sensors for simultaneous contamination causing bilateral idle-specific lean corrections

47. A vehicle has an intermittent P0340 CMP sensor circuit no signal code that sets only during hot operating conditions. The CMP sensor wiring, connector, and resistance all test normal when cold. What should the technician check NEXT?

- A. The PCM CMP input circuit for a fault that develops under thermal load at operating temperature
- B. The CMP sensor reluctor wheel for a crack that only opens under thermal expansion at operating temperature
- C. The CMP sensor air gap for a marginal measurement that increases as components thermally expand at operating temperature
- D. The CMP sensor for an internal fault — a sensor that passes cold testing but fails at operating temperature requires replacement

47. A P0340 CMP no signal code sets only during hot operation. Wiring, connector, and resistance all test normal when cold. What should the technician check NEXT?

- A. The PCM CMP input circuit for a fault developing under thermal load
- B. The CMP reluctor wheel for a crack that opens under thermal expansion
- C. The CMP sensor air gap for a marginal setting that increases as components expand when hot
- D. The CMP sensor for an internal fault that passes cold testing but fails when hot

48. A scan tool shows STFT at -2% and LTFT at -3% on both banks at all engine speeds. No codes are stored. What is the correct interpretation?

- A. A minor rich condition exists — negative trims on both banks at all speeds should be investigated for a cause
- B. Fuel trims are within the normal acceptable operating range — no fault is indicated
- C. The negative LTFT confirms a MAF sensor reading slightly high across the operating range requiring cleaning
- D. A stuck-open EVAP purge solenoid is contributing vapors that are causing the bilateral negative trims

49. A vehicle has a P0505 idle control system malfunction code. The idle is erratic — fluctuating between 500 and 1,200 RPM every few seconds. The throttle body is clean and the IAC valve is confirmed functional by component swap. What should the technician check NEXT?

- A. The PCM for an internal fault causing erratic idle speed commands despite a confirmed functional IAC
- B. A vacuum leak at the intake manifold that opens and closes in response to the engine's changing manifold vacuum during the RPM fluctuation
- C. The TPS for a fault producing erratic throttle position readings that cause the PCM to hunt for idle speed
- D. The MAF sensor for an intermittent fault causing the PCM to alternately add and remove idle air in response to incorrect airflow data

49. P0505 idle control malfunction. Idle fluctuates between 500 and 1,200 RPM. Throttle body is clean and IAC is confirmed functional by swap. What should the technician check NEXT?

- A. The PCM for an internal fault causing erratic idle commands
- B. A vacuum leak that opens and closes in response to changing manifold vacuum during RPM fluctuation
- C. The TPS for erratic throttle position readings causing the PCM to hunt for idle
- D. The MAF sensor for an intermittent fault causing the PCM to alternately add and remove idle air

50. A vehicle has no codes stored, all OBD II monitors complete, and LTFT at +2% on bank 1 and +1% on bank 2. The customer complains of a slight hesitation during cold starts that has been present for several months but clears immediately once the engine warms. What should the technician check FIRST?

- A. The ECT sensor for a resistance fault producing a slightly incorrect temperature reading during cold operation that normalizes as the engine warms
- B. The IAC valve for a fault causing insufficient cold-start idle airflow that resolves once operating temperature is reached
- C. The upstream O2 sensors for slow response during cold operation causing a lean condition before closed-loop entry
- D. The MAF sensor for cold-weather contamination causing a low reading during cold starts that clears with operating temperature

PRACTICE EXAM 13: ANSWER KEY AND EXPLANATIONS

DOMAIN A — GENERAL DIAGNOSIS

1. **B. A single cylinder misfiring on every power stroke at the idle RPM** — A vacuum needle that drops sharply at a consistent, regular interval — once every two seconds at idle — indicates one specific cylinder failing to contribute its power stroke on every firing event. At idle RPM, each cylinder fires at a calculable interval determined by engine speed and cylinder count. A single cylinder misfiring on every one of its power strokes produces a sharp, predictable vacuum drop at exactly that interval. The regularity distinguishes this from a sticking valve — which would produce irregular drops — and from a vacuum leak — which produces a consistently low but stable reading without sharp periodic drops.
2. **D. A blown head gasket or failed cylinder head on the low bank** — Three adjacent cylinders on the same bank all reading between 85 and 95 psi with no wet test improvement is the definitive presentation of a head or gasket failure affecting an entire bank. A head gasket failure that compromises the entire deck surface of one cylinder head — or a cracked cylinder head — reduces compression equally on all cylinders it affects without creating a ring-seal leak that oil can temporarily correct. Worn rings on three cylinders simultaneously would show at least partial wet test improvement on each. The bank-specific pattern with no wet response confirms a head-level fault.
3. **C. Detonation or spark knock from excessive ignition advance or low-octane fuel** — A knock that is present specifically under load, disappears at idle and during deceleration, and is more pronounced when the engine is warm is the classic presentation of detonation. Detonation — also called spark knock — occurs when the air-fuel mixture auto-ignites from heat and pressure before the spark event, producing a sharp metallic knock under combustion load. Idle and deceleration produce insufficient cylinder pressure and temperature for the auto-ignition event, so the knock disappears entirely under those conditions. Warm engine operation increases susceptibility because higher intake charge temperatures lower the detonation threshold.
4. **A. Both the piston rings and head gasket on cylinder 5 have failed simultaneously** — Air escaping from the oil filler cap confirms test air is passing through the piston rings into the crankcase. Coolant bubbling in the radiator simultaneously confirms test air is also entering the cooling system through a head gasket breach. Two separate and distinct leak paths — the crankcase and the cooling system — are confirmed simultaneously on the same cylinder. This requires two

independent seal failures: compromised ring seal and a compromised head gasket. A single failure cannot produce both findings at the same time.

5. **D. Worn valve stem seals allowing continuous oil entry despite normal ring seal** — Heavy blue smoke under all operating conditions with cylinder leakage of only 5% on all cylinders confirms the oil consumption path is not through the piston rings — 5% leakage confirms excellent ring seal integrity. The only remaining internal path for continuous, high-volume oil entry into the combustion chamber with confirmed good ring seal is the valve stems. Severely worn valve stem seals on multiple cylinders allow oil to migrate past the seals continuously under all vacuum conditions — not just the high-vacuum deceleration pattern of early-stage seal wear — producing heavy continuous blue smoke while ring seal remains intact.
6. **B. The head gasket for an internal leak** — The pressure test shows a slow, progressive pressure drop with no visible external leak and confirmed low coolant level. A slow internal leak allows pressurized coolant to migrate from the cooling system into the combustion chamber, oil passages, or both — without producing any visible drip on the outside of the engine. The low coolant level confirms coolant is being lost somewhere. The combination of a slow pressure drop with no external leak and confirmed coolant consumption directs the diagnosis to an internal path — most commonly a head gasket failure — before other internal paths such as the heater core are considered.
7. **C. A fault in the current sensor or test equipment affecting the cylinder 2 reading** — A cylinder that shows normal crank speed — confirming it is mechanically rotating and encountering compression resistance — but zero amperage contribution is producing a contradictory result. If cylinder 2 genuinely had no compression, its crank speed would be faster than normal, not normal speed with zero current. Normal crank speed with zero current reading indicates the compression event is occurring normally but the current measurement system is not registering the resistance for that cylinder. A connection fault in the current clamp, a sensor positioning error relative to cylinder 2's firing interval, or a test equipment fault specific to that channel is the most likely explanation.
8. **D. The idle air control system for insufficient airflow on hot soak restart** — A misfire specifically during hot soak conditions — after the vehicle sits 30–45 minutes following a long drive — that clears within 15 seconds points to a restart condition rather than a running fault. During a hot soak, the engine bay reaches its maximum temperature as coolant and oil stop circulating. A faulty IAC valve that cannot provide sufficient additional airflow during the difficult hot-soak restart condition — when intake air temperature is highest and fuel atomization is poorest — causes a brief lean misfire that resolves once the engine stabilizes and the IAC recovers to its normal operating position.
9. **A. A spark plug with a slightly wide gap misfiring under specific load and vacuum conditions** — A misfire that occurs exclusively above 60 mph under light cruise throttle — but not below that speed or at WOT — points to a fault that is sensitive to the specific combination of moderate

engine speed, light load, and high manifold vacuum present at light-throttle highway cruise. A spark plug with a slightly wide gap requires more secondary voltage to fire than a correctly gapped plug. Under light throttle at highway cruise, the combination of high cylinder pressure from moderate RPM and relatively lean mixture from light throttle creates secondary circuit demand that a marginally gapped plug cannot consistently meet, producing intermittent misfires at that specific operating condition.

10. **B. A hydraulic timing chain tensioner that has bled down during shutdown** — A rattle from the front of the engine that is present immediately on cold start and disappears after 5–10 seconds with confirmed normal oil level and pressure is the specific presentation of a hydraulic timing chain tensioner bleeding down during shutdown. When the engine stops, oil pressure drops to zero and the tensioner's internal check valve may allow oil to drain back slowly over time, creating slack in the timing chain. On startup, oil pressure from the running engine recharges the tensioner within seconds, taking up the chain slack and eliminating the rattle. The 5–10 second resolution time corresponds to the time required for oil pressure to fully recharge the tensioner.
11. **C. Exhaust restriction that progressively collapses vacuum under sustained RPM** — Normal idle vacuum of 18 in/Hg confirms engine health at low load. The gradual, progressive collapse from 20 in/Hg down to 8 in/Hg over 10 seconds at sustained 2,000 RPM is the characteristic pattern of exhaust restriction under sustained elevated flow. As RPM increases, exhaust volume increases proportionally. A restricted exhaust cannot pass the higher flow rate, causing backpressure to build progressively behind the restriction over time. This progressive buildup — rather than an immediate collapse — distinguishes exhaust restriction from a vacuum leak or timing fault, which would produce immediate rather than gradual vacuum change.
12. **A. The PCM defaults to batch-fire injection and the engine may start** — On most sequential port injection systems, the CMP sensor provides cylinder identification that allows the PCM to sequence injector firing in the correct order relative to each cylinder's intake stroke. When the CMP signal is lost, many PCMs default to a batch-fire or group-fire injection strategy — firing injectors in pairs or groups rather than sequentially — rather than completely disabling injection. This default strategy allows the engine to start and run, though typically with reduced efficiency and potentially rough idle. The CKP signal, which is confirmed present, continues to provide engine speed and approximate position data sufficient for the batch-fire fallback strategy.

DOMAIN B — IGNITION SYSTEM DIAGNOSIS AND REPAIR

13. **D. Oil fouling from worn valve stem seals or piston rings** — A wet, oily black deposit covering the entire insulator and electrode with minimal electrode wear indicates liquid oil is reaching the combustion chamber and coating the plug surfaces rather than being burned in normal combustion. Oil fouling differs from carbon fouling — carbon fouling produces a dry, sooty black deposit from incomplete combustion of the air-fuel charge, while oil fouling produces a wet, shiny, heavier black coating from oil contamination. The oil source is either worn valve stem seals allowing oil

to migrate down the valve stem or worn piston rings allowing oil past the oil control rings — both produce this characteristic wet oily plug appearance.

14. **B. The coil primary winding may be shorted — 0.4 ohms is below the minimum specification** — A primary winding resistance of 0.4 ohms against a specification of 0.5–1.5 ohms is below the minimum acceptable value. A resistance reading below specification indicates the winding has fewer effective turns than designed — consistent with an internal short circuit between winding turns. A shorted primary winding allows higher-than-normal current to flow during dwell, potentially damaging the PCM output driver over time, and reduces the magnetic field intensity due to the shortened effective winding length. While the coil may still produce spark, it is operating outside its designed parameters and should be replaced.
15. **C. A spark plug with a narrower-than-normal gap on that cylinder** — Spark line duration represents the time the arc is sustained across the spark plug gap — it is directly proportional to gap size and inversely proportional to the current available to sustain the arc. A narrower gap requires less voltage to initiate the arc and sustains at lower current, allowing the available secondary energy to maintain the arc for a longer duration before the stored energy is depleted. A plug gapped significantly tighter than specification burns longer because the same stored coil energy is delivered across a shorter gap, extending the arc duration while reducing arc intensity. This produces the extended spark line duration observed on that specific cylinder.
16. **A. A chipped, missing, or damaged reluctor tooth on the camshaft trigger wheel** — A Hall effect CMP sensor signal that switches correctly for most of the camshaft revolution but drops out completely for approximately 0.2 seconds at the same position every revolution indicates a physical absence or damage at that specific tooth location on the trigger wheel. The dropout occurs at a consistent position every revolution — confirming a fixed physical fault rather than an electrical intermittent. A missing or severely chipped tooth provides no triggering surface for the Hall effect sensor at that position, causing the signal to remain at its resting state for the duration of time that position passes the sensor — producing the 0.2-second dropout observed.
17. **D. The cylinder 1 plug wire has high resistance and is the cause of the misfire** — The coil serving cylinders 1 and 6 is confirmed good by swap testing — the fault is not in the coil. When the cylinder 1 plug wire is swapped with the cylinder 6 wire, the misfire moves from cylinder 1 to cylinder 6, confirming the fault traveled with the wire to its new location. On a waste spark system, the coil fires both cylinders in the pair simultaneously through their respective plug wires — a high-resistance wire on cylinder 1 causes a misfire on cylinder 1 while the cylinder 6 wire is unaffected. The misfire following the wire to its new cylinder position definitively confirms the wire as the cause.
18. **B. Electromagnetic interference from an adjacent ignition or accessory circuit** — A magnetic reluctance CKP waveform that is otherwise normal but shows random, intermittent voltage spikes between tooth signals — not at a consistent position — points to an external interference source rather than a physical reluctor wheel fault. A reluctor wheel fault produces consistent signals at the

same position every revolution. Random spikes between teeth that do not correlate to any specific rotational position are characteristic of electromagnetic interference from a nearby high-voltage source — such as a secondary ignition wire routed too close to the CKP wiring, or an accessory component inducing voltage into the sensor circuit through proximity or shared ground path.

19. **C. A shared power supply or ground circuit for the bank 2 coils** — Confirmed misfires on three cylinders that are all on the same bank, with coil, plug, and injector swaps ruling out individual component faults, points to a fault in the shared electrical infrastructure serving all three coils simultaneously. Multiple cylinders on the same bank sharing a common power supply wire, a common ground connection, or a shared PCM reference circuit explains why all three fail simultaneously while the opposite bank functions normally. An open or high-resistance shared ground or power feed would reduce available current for all coils connected to that circuit, producing simultaneous misfires across all affected cylinders.
20. **D. Excessive secondary voltage from a high-output aftermarket coil causing accelerated electrode erosion** — A ground electrode worn completely away with the center electrode worn to a nub represents extreme erosion beyond what normal extended service wear produces. Normal wear at the recommended service interval produces rounded electrodes and a widened gap — not complete electrode loss. An aftermarket high-output coil producing secondary voltage significantly above OEM specification generates spark arcs with substantially higher energy than the plug is designed to withstand, accelerating electrode erosion dramatically with each firing event. The extreme erosion pattern on both electrodes — not just one — is consistent with high-energy arc damage rather than single-sided wear from a directional fault.

DOMAIN C — FUEL, AIR INDUCTION, AND EXHAUST SYSTEMS

21. **D. A failed pump check valve or slow injector leakage allowing overnight drain-back** — The 20-minute pressure retention from 62 to 58 psi confirms the system has no significant rapid drain-back — a 4 psi drop over 20 minutes is minor and may represent normal thermal contraction. However, the overnight drop from 58 psi to 14 psi confirms a slow but significant leak path that only becomes apparent over hours. On a returnless system, the pump check valve is the primary pressure retention component after shutdown. A check valve that slowly bleeds back — or injectors with very slight internal leakage — allows gradual overnight pressure loss to the low residual level observed. The rate of loss distinguishes a slow drain-back from a failed check valve that would drop pressure within minutes.
22. **B. A MAF sensor reading significantly above actual airflow specifically at idle** — A MAF reading more than double the specified idle value combined with strongly negative LTFT that recovers fully at 2,500 RPM is the specific pattern of a MAF sensor that over-reads at low airflow rates but becomes more accurate as airflow increases. At idle, the inflated MAF reading causes the PCM to massively over-deliver fuel, requiring -21% LTFT correction. At 2,500 RPM where actual airflow is much higher, the same sensor may read more accurately relative to actual flow, allowing trims to recover toward zero. This idle-specific over-reading pattern with high-RPM recovery is

the diagnostic signature of a MAF sensor with contamination concentrated on the hot-wire sensing element.

23. **A. The fuel pressure regulator is stuck open allowing excessive fuel return** — When pinching the return line causes pressure to immediately rise to specification, the pump is confirmed capable of generating and delivering adequate pressure to the rail. The instant pressure recovery confirms the pump is not weak — it was delivering adequate pressure all along, but excess fuel was being returned through the regulator before it could build rail pressure. A regulator stuck in the open position or with a collapsed spring allows nearly unrestricted fuel return at all times, preventing rail pressure from reaching specification regardless of pump output. The return-line pinch test is the definitive confirmation of this fault.
24. **C. The ECT sensor and its circuit for a fault producing an elevated reading** — Before pursuing cooling system component diagnosis on an ECT reading of 248°F — significantly above the 190–215°F specification — the accuracy of the temperature measurement must be confirmed. An ECT sensor with a drifting thermistor or a signal circuit with a fault can produce falsely elevated readings without the engine genuinely overheating. The absence of an overheating warning light — which typically activates at a lower threshold than 248°F — and the high-speed fan operation suggest the PCM is responding to what it believes is a high temperature reading. Confirming actual coolant temperature with an infrared thermometer or a known-good sensor verifies whether the reading is accurate before any cooling system component is replaced.
25. **A. Carbon deposits on intake valves restricting airflow and causing lean misfires** — Compression and ignition are confirmed normal, and the high-pressure rail is at correct pressure — eliminating fuel supply and ignition faults. A borescope confirms significant carbon buildup on the intake valves. Carbon deposits that have accumulated to a significant thickness restrict the effective flow area through the intake port, reducing the volume of air-fuel charge delivered to the combustion chamber on each intake stroke. The resulting lean condition — insufficient charge volume — causes misfires that appear as random P030X codes. The carbon buildup on GDI intake valves, caused by the absence of fuel washing as in port injection systems, is the confirmed physical cause of the restricted airflow.
26. **B. Replace the cracked vacuum hose and retest LTFT** — The smoke test has directly identified the specific fault — a cracked vacuum hose near the bank 1 intake manifold. The bank 2 LTFT of +3% confirms the shared systems are functioning correctly. The correct repair is to address the identified fault directly — replacing the cracked hose — and retesting LTFT after a sufficient drive cycle to confirm the lean condition has resolved. Replacing the manifold gasket simultaneously without evidence of its failure wastes parts and adds unnecessary labor. Retesting LTFT after the hose replacement confirms whether the identified leak was the sole cause of the bank 1 lean condition.
27. **C. The wastegate actuator for a mechanical fault preventing closure beyond the spring pressure limit** — The wastegate solenoid is functioning — it is receiving and transmitting the

PCM's command to hold the wastegate closed. Despite the commanded closed position, boost cannot exceed 12 psi at any RPM. A maximum boost level that corresponds to the wastegate spring pressure setting — regardless of solenoid command — indicates the wastegate actuator cannot be held closed beyond the spring's natural opening point. A ruptured actuator diaphragm, a cracked actuator housing, or a physically stuck-open wastegate allows the turbine exhaust pressure to overcome the actuator and open the wastegate at its natural spring pressure, creating a hard boost ceiling regardless of the PCM's solenoid command.

28. **A. Normal behavior — a brief pressure drop during snap-throttle is expected** — A sudden wide-open throttle demand creates an instantaneous spike in fuel flow demand that briefly exceeds the steady-state pump output. A momentary 12 psi pressure drop that recovers completely within 2 seconds is within the expected behavior of a healthy fuel system responding to a sudden high-demand event. The pump catches up to the sudden demand within the normal recovery window and restores specification pressure quickly. A failing pump would show a larger pressure drop, a slower recovery, or an inability to fully restore specification pressure. A clogged filter would typically also show reduced idle pressure. The brief, self-recovering drop is not a fault.
29. **C. The EVAP purge solenoid for a stuck-open condition adding excess vapor** — Fuel pressure is within specification, injector balance confirms equal delivery across all cylinders, and the rich condition is present at all engine speeds on both banks simultaneously. With fuel delivery confirmed balanced and fuel pressure normal, a shared system adding fuel vapor to both banks equally at all operating conditions is the remaining most likely cause. A stuck-open EVAP purge solenoid continuously delivers fuel vapors from the charcoal canister directly into the intake manifold, adding unmetered fuel to both banks simultaneously at all engine speeds. This produces the bilateral, all-speed negative LTFT pattern that cannot be attributed to injector, pressure, or MAF sensor faults.
30. **A. A partially clogged catalytic converter substrate restricting exhaust flow** — Backpressure of 4.8 psi at 2,500 RPM significantly exceeds the 3.0 psi maximum specification, confirming abnormal exhaust restriction under increased flow demand. The combination of low power under load, correct idle performance, and elevated backpressure above the maximum specification at 2,500 RPM is the definitive diagnostic pattern of a catalytic converter with partially collapsed or clogged substrate. At idle, exhaust flow is low enough that the restriction has minimal effect. As RPM and load increase, the increasing exhaust volume encounters the restriction, building backpressure that progressively limits engine breathing and power output.

DOMAIN D — EMISSIONS CONTROL SYSTEMS

31. **A. The intake manifold PCV port has a carbon restriction** — The fresh air inlet is confirmed unobstructed and the PCV valve rattles freely — both sides of the ventilation system appear functional at their respective components. However, very weak vacuum at the intake manifold PCV port with confirmed airflow capability at the valve cover side indicates the vacuum source at the manifold is compromised. The most common cause of weak manifold vacuum at the PCV port

on an otherwise functional PCV system is carbon buildup restricting the manifold port itself — the small orifice where crankcase vapor enters the intake manifold. This restriction limits the vacuum available to draw crankcase gases through the circuit despite correct function of all other PCV components.

32. **B. An ignition misfire delivering unburned fuel causing catalyst overheating and NO_x** — A P0300 random misfire with elevated NO_x and near-neutral LTFT of -2% on both banks confirms the mixture is near stoichiometry and no persistent lean or rich condition is causing the NO_x elevation. An ignition system misfire delivers complete unburned fuel charges to the catalytic converter. The converter attempts to oxidize this raw fuel, generating substantial exothermic heat in the process. Sustained converter overheating from misfire-delivered HC degrades the rhodium reduction catalyst, reducing its ability to convert NO_x — the elevated NO_x at the tailpipe is the result of a thermally damaged catalyst that has lost its NO_x reduction efficiency from repeated misfire-induced overheating events.
33. **B. The vent solenoid is opening correctly and allowing tank pressure to equalize** — A bi-directional test commanding the vent solenoid open produces a fuel tank pressure drop from +0.5 in/Hg to 0.0 in/Hg. This confirms the solenoid is physically opening and allowing the slightly pressurized fuel tank to vent to atmospheric pressure — which is exactly what the vent solenoid is designed to do when commanded open. The tank pressure equalizing to zero when the vent opens is the expected, correct result. The P0446 vent circuit code with a confirmed functionally correct vent solenoid indicates the fault lies elsewhere in the vent system — a blocked vent tube, a downstream restriction, or incorrect sensor feedback during the monitor's evaluation of vent circuit integrity.
34. **C. The ignition components on cylinder 1 — coil, plug, and wire — for a fault causing the misfire** — A P0301 cylinder 1 misfire code with elevated HC at the tailpipe and near-neutral LTFT on both banks directly identifies cylinder 1 ignition as the first diagnostic target. Neutral LTFT eliminates a mixture fault as the misfire cause. Each time cylinder 1 misfires from an ignition fault, its complete unburned fuel charge passes through the exhaust system, dramatically elevating HC at the tailpipe. The systematic approach to a single-cylinder ignition misfire is to check the coil, spark plug, and plug wire on that cylinder in sequence — the most common and most testable ignition causes before pursuing fuel delivery or mechanical faults.
35. **A. The AIR distribution system for a fault on the bank 2 side** — The AIR pump is confirmed running and bank 1 shows a strong lean response — confirming the pump is generating adequate air output for at least one bank. Bank 2 shows no lean response despite the pump running. With confirmed adequate pump output confirmed by bank 1's response, the absence of a lean signal on bank 2 indicates the air is not reaching the bank 2 exhaust ports. The fault is localized to the bank 2 delivery side of the AIR system — a blocked distribution tube preventing air from reaching the bank 2 exhaust ports, a failed check valve on the bank 2 side blocking air delivery, or a disconnected hose between the pump output and the bank 2 distribution manifold.

36. **D. A P0457 code is only set when the fuel cap is actually loose — a vapor line crack would generate a different code** — OBD II EVAP leak codes are classified by severity and confirmed source. A P0457 code specifically indicates the OBD II system detected a large EVAP leak that the system attributed to a loose or missing fuel cap based on the system's diagnostic logic — typically because the leak was detected at the point where the system first checks for a cap seal. A cracked vapor line that creates a large leak would typically generate a P0455 large EVAP leak code rather than a P0457 cap-specific code. The specific code designation provides diagnostic direction — but physical smoke testing always confirms the actual leak location regardless of the code's implied source.
37. **C. A downstream O2 sensor contaminated or failed with its element biased toward the rich voltage range** — The downstream sensor reads a fixed 0.75–0.85 volts without switching at any operating condition. The upstream sensor is switching normally, confirming the upstream mixture control is functioning correctly. LTFT at -3% is essentially neutral — no persistent rich condition exists that would drive the downstream sensor to a sustained high reading from actual exhaust composition. A sensor that reads consistently in the rich voltage range without switching despite normal upstream operation and neutral fuel trims has a failed or contaminated sensing element that is no longer responding to exhaust oxygen content — it is outputting a default high voltage independent of actual exhaust conditions.

DOMAIN E — COMPUTERIZED ENGINE CONTROLS INCLUDING OBD II

38. **C. Fuel trims are within the normal operating range — no fault is indicated** — STFT at +2% to +3% and LTFT at +2% to +3% on both banks at all engine speeds represent minimal fuel corrections well within the universally accepted normal operating range of $\pm 10\%$. These values confirm the PCM is making only very small adjustments to the base fuel delivery calculation — indicating the air-fuel metering system has no significant fault. The consistency of trims across both banks and all RPM ranges confirms there is no bank-specific or RPM-specific fault developing. Near-zero fuel trims across all operating conditions with no stored codes confirm a correctly functioning closed-loop fuel control system.
39. **A. A vacuum leak at or near the bank 1 throttle body base is confirmed** — The propane enrichment test response is the definitive functional confirmation of a vacuum leak. Propane directed near the bank 1 throttle body base improves idle quality and causes LTFT to begin moving toward zero, confirming propane is being drawn into the intake tract through a leak at that location. The propane temporarily compensates for the unmetered air entering through the leak, enriching the mixture toward stoichiometry and reducing the PCM's required LTFT correction. This response specifically confirms the leak location — at or near the throttle body base — rather than simply confirming a leak exists somewhere on bank 1.
40. **D. Normal PCM behavior during deceleration fuel cutoff** — During deceleration fuel cutoff, the PCM intentionally stops injector firing to reduce fuel consumption and emissions. With no fuel being delivered, the exhaust contains no combustion products — only residual air from the

cylinders pumping atmospheric air past the throttle. The upstream O2 sensor detects this oxygen-rich, fuel-free exhaust and reads a fixed lean voltage of 0.1 volts. Simultaneously, the STFT climbs to +22% as the PCM preloads a rich correction in preparation for throttle reopening and fuel delivery resumption. The immediate return to normal STFT and O2 switching at throttle reopening confirms this is a controlled, normal PCM response rather than a fault.

41. **C. One or more bank 1 fuel injectors are leaking and contributing excess fuel** — The bi-directional test commanding all bank 1 injectors off eliminates fuel delivery through those injectors as a variable. When LTFT bank 1 moves toward zero within 15 seconds of all injectors being disabled, the excess fuel that was causing the -20% rich correction stops entering the engine — confirming the injectors were the source. A MAF fault or O2 sensor contamination would not respond to injector disable because those faults exist independently of injector command. With all bank 1 injectors off and trims recovering, at least one injector is confirmed leaking fuel into the cylinder even when electrically commanded off.
42. **A. The vehicle appears ready for emissions inspection** — All OBD II monitors are confirmed complete, LTFT is +2% on both banks — well within the normal operating range — and no codes are stored. These three conditions together confirm the vehicle has completed the required monitor drive cycles, no active or pending faults exist, and the fuel control system is operating correctly near stoichiometry. A vehicle meeting all three criteria has satisfied the standard OBD II readiness requirements for emissions inspection. Additional testing or drive cycles are not required or indicated when all three key readiness criteria are simultaneously satisfied.
43. **A. The PCM connector and grounds for collision damage before condemning the PCM** — A P0601 internal PCM memory checksum error following a minor front-end collision may indicate actual PCM internal damage — but may also result from connector damage, bent pins, or a disrupted ground connection caused by the collision impact. Before condemning the PCM and authorizing replacement, the technician should inspect the PCM connector for damaged or displaced pins, inspect the PCM mounting for physical damage, and verify all PCM ground connections are intact and making solid contact. Collision impact can dislodge connectors, damage ground straps, or create marginal connections that produce internal PCM codes without the PCM itself being physically damaged internally.
44. **B. A vacuum leak causing a lean condition that is most severe during light-throttle cruise** — A P0300 random misfire worse during light-throttle cruise with LTFT at +18% at idle dropping to +4% at cruise points to a vacuum leak as the primary cause. The highest manifold vacuum in normal engine operation occurs during light-throttle cruise — more vacuum than at idle because RPM is higher with the throttle barely open. A vacuum leak's lean effect is proportional to available manifold vacuum — it is greatest during light-throttle cruise where vacuum is highest, producing the most severe lean condition and the most frequent misfires under those conditions. The idle LTFT confirming a lean condition and the cruise-specific misfire worsening are both consistent with a vacuum leak.

45. **A. The upstream O2 sensor for contamination or slow response** — The new catalytic converter has been installed and is physically intact, yet the downstream sensor continues to switch at the same rate as the upstream sensor — a pattern that generated the original P0420. Before concluding the new converter has also immediately failed, the upstream O2 sensor must be evaluated. A contaminated or slow-response upstream sensor does not switch cleanly between rich and lean states — its sluggish transitions prevent the catalyst from receiving the correct mixture cycling needed to store and release oxygen effectively. The catalyst monitor evaluates the downstream sensor's response relative to the upstream sensor — a slow upstream sensor undermines accurate catalyst efficiency evaluation regardless of converter condition.
46. **C. The MAF sensor for a contamination fault that underreads at low-airflow idle** — Strongly positive LTFT on both banks at idle that drops significantly at 2,500 RPM with a confirmed correct static MAF voltage reading at idle is the specific pattern of MAF contamination that underreads proportionally at low airflow but reads more accurately as airflow increases. A static MAF voltage check at idle may fall within specification while still underreporting actual airflow — the voltage can appear correct in a narrow static check while the dynamic airflow calculation is inaccurate. The idle-specific bilateral lean condition with high-RPM recovery that persists despite a seemingly correct static reading is the diagnostic signature that directs the technician to dynamic MAF testing or replacement.
47. **C. The CMP sensor air gap for a marginal setting that increases as components expand** — The sensor's wiring, connector, and resistance all test normal when cold — confirming no cold-state electrical fault. A P0340 that appears only during hot operation, with confirmed cold circuit integrity, points to a physical or thermal fault that only manifests at operating temperature. A CMP sensor installed with a marginally acceptable air gap — at the upper limit of its specification — may function correctly when cold but lose adequate signal generation as the aluminum cylinder head, camshaft, and sensor housing thermally expand at operating temperature. Thermal expansion increases the air gap beyond the acceptable limit, weakening the signal below the PCM's minimum detection threshold and setting the code.
48. **B. Fuel trims are within the normal acceptable operating range — no fault is indicated** — STFT at -2% and LTFT at -3% on both banks at all engine speeds represent minimal fuel corrections well within the normal $\pm 10\%$ accepted operating range. These values indicate the PCM is making only very small reductions to fuel delivery — consistent with a mixture that is slightly rich relative to stoichiometry but well within the range of normal variation. The bilateral symmetry at all engine speeds with no stored codes confirms no fault is present. Near-zero negative trims are as normal and acceptable as near-zero positive trims — neither direction requires investigation unless the magnitude exceeds the normal threshold.
49. **C. The TPS for erratic throttle position readings causing the PCM to hunt for idle** — The IAC valve is confirmed functional by component swap, eliminating the valve itself as the cause. The throttle body is clean, eliminating carbon-related airflow faults. Erratic idle oscillation

between 500 and 1,200 RPM with a confirmed functional IAC points to incorrect input data driving the erratic idle command rather than a fault in the idle air delivery hardware. A TPS with a worn resistive element or a failing wiper contact that produces erratic voltage signals at the near-closed throttle position causes the PCM to misread idle throttle position continuously — responding to phantom throttle inputs by alternately adding and removing idle air, producing the characteristic hunting idle pattern.

50. **A. The ECT sensor for a resistance fault producing a slightly incorrect cold temperature reading** — All monitors are complete and trims are near zero — confirming no active faults are present. A persistent cold-start hesitation that resolves immediately upon warm-up with no stored codes points to a calibration drift in a sensor that affects cold operation but normalizes within the warm operating range. The ECT sensor governs cold-start fuel enrichment, ignition timing advance, and idle speed — all of which affect cold-start smoothness. A sensor with a slightly high resistance reading that causes the PCM to perceive the engine as slightly warmer than actual during cold starts delivers insufficient enrichment for the actual temperature, producing the brief hesitation that clears as the engine warms and the temperature reading normalizes within its accurate range.