

PRACTICE EXAM 16: 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 17 in/Hg with a needle that floats erratically between 14 and 20 in/Hg at an irregular, unpredictable interval. RPM is stable. What does this MOST likely indicate?

- A. Retarded ignition timing reducing average vacuum and causing the needle to hunt
- B. A sticking valve that seats inconsistently — each time it sticks the needle drops and when it reseats the needle recovers
- C. A vacuum leak that opens and closes intermittently from engine vibration
- D. Worn piston rings on multiple cylinders causing random compression variations

2. A 6-cylinder engine compression test shows cylinders 1, 2, 4, 5, and 6 between 160 and 175 psi. Cylinder 3 reads 160 psi dry and 161 psi wet. What does the minimal wet test improvement on cylinder 3 indicate?

- A. Worn piston rings — wet test improvement of 1 psi confirms a borderline ring seal fault
- B. Carbon deposits reducing cylinder 3 volume — oil cannot correct a volume-related fault
- C. A head gasket breach on cylinder 3 — oil cannot seal a gasket leak explaining the minimal wet improvement
- D. A burned or damaged valve on cylinder 3 — oil cannot seal a valve face leak explaining no wet improvement

3. An engine has a knock that is present at idle, increases significantly under load, and can be temporarily eliminated by retarding ignition timing. What is the MOST likely cause?

- A. Detonation or spark knock — the knock being timing-sensitive confirms ignition advance as the contributing factor
- B. Worn connecting rod bearings — load sensitivity is the defining characteristic of rod bearing knock
- C. Piston slap from excessive bore clearance — timing adjustment temporarily unloads the piston
- D. A loose torque converter that amplifies under load and responds to RPM changes from timing retard

4. A cylinder leakage test on cylinder 6 shows 28% leakage. Air escaping is heard from the exhaust pipe only. The maximum specification is 20%. What does this indicate?

- A. A head gasket breach on cylinder 6 routing test air into the exhaust manifold via a combustion-to-exhaust passage
- B. Worn piston rings on cylinder 6 — ring blow-by routes test air into the crankcase and then to the exhaust via PCV
- C. A leaking exhaust valve on cylinder 6 allowing test air to flow past the valve face directly into the exhaust system
- D. A leaking intake valve on cylinder 6 — air is being drawn backward from the exhaust through the combustion chamber

5. An engine has white smoke from the exhaust under all operating conditions that does not clear after full warm-up. The smoke has a sweet smell. Coolant level is dropping. What is the MOST likely cause?

- A. Rich combustion producing water vapor that persists beyond normal warm-up duration
- B. A head gasket failure or cracked head allowing coolant to enter the combustion chamber and burn
- C. A ruptured power brake booster diaphragm drawing coolant vapor into the intake system
- D. Excessive PCV system flow drawing moisture-laden crankcase vapor into the intake at all times

6. A cooling system pressure test is performed with the engine at operating temperature. The system holds 15 psi for 5 minutes then begins dropping slowly — 1 psi per minute. No external drips are visible. The engine oil appears normal. What should the technician check NEXT?

- A. The head gasket for a combustion-side breach allowing pressurized coolant to enter the cylinders
- B. The radiator for pinhole leaks in the core that only weep under sustained hot pressure
- C. The water pump weep hole for a seal failure that only activates under hot pressurized conditions
- D. The heater core for an internal leak draining into the HVAC housing without external visibility

7. A relative compression test is performed with all injectors disabled. Cylinders 1 through 7 show consistent crank speed and amperage. Cylinder 8 shows normal average crank speed but the amperage trace shows a brief spike — significantly higher than all other cylinders — at exactly one point per revolution. What does this MOST likely indicate?

- A. A CKP signal error near the cylinder 8 position causing a false amperage spike in the relative test
- B. A partially stuck closed valve on cylinder 8 creating extra compression resistance on specific strokes
- C. Carbon buildup on the cylinder 8 piston or head raising effective compression ratio and causing the brief amperage spike
- D. A hydraulic lifter on cylinder 8 that is intermittently collapsing and over-extending during the compression test

8. An engine has a knock that is present only when cold and disappears completely after 2–3 minutes of warm-up at all RPM and loads. Oil level and pressure are normal. What is the MOST likely cause?

- A. Piston-to-bore clearance that is excessive when cold — the aluminum pistons expand with heat and eliminate the clearance that causes piston slap
- B. A hydraulic lifter that bleeds down during shutdown and requires 2–3 minutes to fully recharge at operating oil pressure
- C. A worn crankshaft main bearing that tightens with thermal expansion of the crankshaft journal after warm-up

D. Timing chain slack that is present when cold oil is less viscous and disappears when oil viscosity increases at operating temperature

9. An engine has blue smoke only during deceleration — specifically during engine braking from highway speeds with the throttle completely closed. No smoke at idle, acceleration, or cruise. Compression is normal. What is the MOST likely cause?

A. Worn oil control rings that allow oil consumption specifically under the high cylinder pressures of deceleration engine braking

B. Worn valve stem seals that allow oil to be drawn into the combustion chambers under the high intake vacuum of closed-throttle deceleration

C. A stuck-open PCV valve drawing oil vapor specifically under the high vacuum of closed-throttle deceleration

D. A leaking valve cover gasket allowing oil to contact the exhaust manifold at the elevated temperatures of deceleration

10. A technician performs a cylinder contribution test at idle. All cylinders drop 190–210 RPM when individually disabled except cylinder 2, which drops only 40 RPM. No codes are stored. What should the technician check FIRST?

A. The fuel injector on cylinder 2 for a restriction causing lean delivery

B. The compression on cylinder 2 for a mechanical fault causing reduced contribution

C. The spark plug and coil on cylinder 2 for an ignition fault

D. The cylinder 2 injector circuit for an open or high-resistance fault causing confirmed minimal fuel delivery to that cylinder

11. A vacuum gauge test at 2,500 RPM under light load shows vacuum dropping from 20 in/Hg to 6 in/Hg progressively over 8 seconds of sustained RPM, then recovering when RPM is reduced. This pattern repeats consistently. What is the MOST likely cause?

- A. Worn valve springs causing valve float under sustained RPM that progressively reduces pumping efficiency
- B. A single badly misfiring cylinder causing progressive vacuum buildup from unburned charge in the exhaust
- C. A clogged or restricted catalytic converter building backpressure progressively under sustained elevated exhaust flow
- D. Retarded ignition timing causing progressive combustion inefficiency under sustained load conditions

12. A no-start condition exists on a vehicle with a distributor ignition system. Spark is confirmed at the coil wire. No spark is present at any plug wire. The distributor cap and rotor are visually normal. The engine cranks normally. What should the technician check NEXT?

- A. The rotor for a carbon tracking fault allowing secondary voltage to short to ground inside the cap rather than reaching the terminals
- B. The ignition coil secondary winding for an open preventing high voltage delivery to the distributor
- C. The pickup coil inside the distributor for a fault preventing the trigger signal from reaching the ignition module
- D. The distributor cap for internal carbon tracking between terminals that is not visible externally

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

13. A spark plug removed from a high-mileage engine shows a rounded center electrode and a rounded ground electrode with a noticeably wider-than-specified gap. The insulator is light gray. No deposits are present. What does this indicate?

- A. Detonation damage causing erosion of both electrodes from repeated abnormal combustion pressure spikes
- B. Normal wear at or beyond the recommended service interval — electrode erosion and gap widening are expected at high mileage
- C. Pre-ignition damage melting both electrodes from sustained extreme thermal events

D. Carbon fouling from rich combustion that has self-cleaned but left behind electrode erosion from the cleaning process

14. A P0352 ignition coil B primary circuit code is stored. The coil B supply voltage is 12.3 volts. The PCM command wire reads 11.9 volts at rest. When the PCM commands the coil, the command wire voltage drops to 11.4 volts instead of near zero. No spark is produced on coil B. What does the voltage drop to 11.4 volts instead of near zero indicate?

A. The coil B primary winding is open — preventing full current from flowing and limiting the voltage drop

B. A ground fault in the coil B primary circuit is creating a partial voltage drop rather than a complete ground

C. The PCM driver for coil B is functioning — the 11.4-volt drop confirms partial grounding consistent with normal operation

D. The PCM driver for coil B has high internal resistance or is failing — it is attempting to ground the circuit but cannot pull it to near zero

14. Coil B supply is 12.3 V. Command wire reads 11.9 V at rest and drops to only 11.4 V when commanded. No spark from coil B. What does the minimal voltage drop indicate?

A. An open coil B primary winding preventing current flow

B. A partial ground fault in the coil B primary circuit

C. Normal PCM driver operation — partial drop is expected

D. A failing PCM driver that cannot pull the command wire to near zero

15. A secondary ignition scope waveform on a waste spark system shows one coil with a normal primary pattern but the firing line on one of its two cylinders is significantly higher than the other cylinder on the same coil. The high-firing-line cylinder has no misfire code. What is the MOST likely cause?

A. A shorted spark plug on the high-firing-line cylinder providing a resistive path that raises required firing voltage

- B. A loose or corroded secondary terminal connection reducing the effective load on the low-firing-line cylinder
- C. A spark plug with a wider-than-normal gap on the high-firing-line cylinder requiring more voltage to initiate the arc
- D. A high-resistance plug wire on the low-firing-line cylinder reducing its firing line height and making the other appear high by comparison

16. A Hall effect CMP sensor is suspected of intermittent failure. The sensor supply voltage and ground are confirmed correct. A lab scope during normal operation shows the signal switching cleanly between 0 and 5 volts. During a cold ambient temperature test at 20°F, the signal intermittently sticks at 5 volts for 0.3–0.5 seconds before resuming normal switching. What is the MOST likely cause?

- A. A Hall effect sensor with a temperature-sensitive internal circuit element that intermittently fails to switch low at cold temperatures
- B. The PCM input pull-up resistor is temperature-sensitive and intermittently holds the signal high during cold operation
- C. Ice formation on the sensor face intermittently blocking the trigger wheel teeth from activating the Hall element
- D. The CMP trigger wheel has thermal contraction at 20°F that intermittently increases the air gap beyond the sensor's detection range

17. A DIS system fires cylinders 1-4 and 2-3 as paired waste spark cylinders. After a tune-up replacing all plugs and wires, a P0301 misfire code sets on cylinder 1 only. The cylinder 1 plug and wire are confirmed correctly installed. Cylinder 4 has no misfire code. What should the technician check NEXT?

- A. The coil serving cylinders 1 and 4 for a fault that only affects the cylinder 1 firing direction
- B. The cylinder 1 coil boot seating on the newly installed spark plug for incomplete contact
- C. The PCM driver for the cylinder 1 and 4 coil for a fault preferentially affecting the cylinder 1 firing event
- D. The cylinder 1 spark plug for an incorrect heat range installed during the tune-up

18. A magnetic reluctance CKP sensor waveform shows normal tooth amplitude throughout except at the reference gap — the engineered missing tooth position — where the waveform shows a large positive voltage spike instead of the expected dropout to zero. What is the MOST likely cause?

- A. The PCM is generating a reference pulse at that position — the positive spike is a normal PCM sync pulse
- B. Debris or a metallic particle has lodged at the reference gap position and is producing a false magnetic event
- C. The reference gap teeth on either side of the gap have excessive clearance producing a positive induction artifact
- D. The CKP sensor polarity is reversed — the reference gap produces a positive spike when wiring is swapped

19. A COP ignition system has confirmed misfires on cylinders 3 and 7. These two cylinders are on opposite banks. Swapping the coils from cylinders 3 and 7 to confirmed-good positions moves both misfires — P0303 and P0307 go away and the new cylinder positions develop misfires. Swapping the spark plugs from cylinders 3 and 7 does not move the misfires back. What does this confirm?

- A. Both plug wires on cylinders 3 and 7 have simultaneously failed — but this is a COP system, so wires are not the cause
- B. Both spark plugs from cylinders 3 and 7 have fouled — the plug swap to different positions should have moved the misfires but did not
- C. Both coils from cylinders 3 and 7 have failed — the misfires moved with the coils and the plugs are not the cause
- D. The PCM driver circuits for cylinders 3 and 7 have simultaneously failed — the coil swap confirms the drivers, not the coils

20. A technician is testing a COP coil primary winding with a DVOM. The specification is 0.7–1.3 ohms. The coil reads 0.0 ohms. What does a 0 ohm reading indicate?

- A. The coil primary winding has an open circuit — no resistance path exists between the terminals

- B. The coil primary winding has a short circuit — the winding is shorted internally reading near zero resistance
- C. The DVOM leads need to be zeroed — a 0.0 ohm reading is always a meter calibration issue on this range
- D. The coil primary winding is within specification — 0.0 ohms is within the lower end of the 0.7–1.3 ohm range

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

21. A port injection engine has a fuel pressure specification of 55–60 psi. At key-on the system pressurizes to 58 psi. After 30 minutes key-off, pressure is 12 psi. The return line is confirmed unobstructed. After pinching the fuel supply line at the rail and waiting 30 minutes, pressure drops to 55 psi. What does this confirm?

- A. The fuel pump check valve is intact — pressure holds with the supply line pinched, confirming the leak is downstream through the injectors
- B. The fuel filter is leaking internally — the pinch test bypasses the filter and confirms its integrity
- C. The fuel pump check valve is faulty — pressure holds with the supply pinched confirming the pump is the drain-back source
- D. The injector return circuit has a restriction causing pressure to back-feed through the pump when supply is pinched

22. A scan tool shows LTFT at -2% and -1% on both banks at all speeds. No codes are stored. The engine runs smoothly. What is the correct interpretation?

- A. A slightly rich condition is present — further diagnosis of injectors or MAF is recommended
- B. The fuel system is slightly over-delivering — the regulator should be tested before the next service
- C. These values are within normal operating range — minor negative trims on both banks at all speeds indicate no significant fault
- D. LTFT of -2% and -1% are within the $\pm 10\%$ normal operating range — no fault is indicated and no further action is required

23. A return-style fuel system has correct idle pressure of 57 psi with the vacuum line disconnected. With the vacuum line connected at idle, pressure drops to 51 psi — within the 6–8 psi expected drop. Under hard acceleration, pressure drops to 38 psi before recovering. The specification is 50 psi minimum under load. What should the technician check FIRST?

- A. The fuel pressure regulator for a fault causing excessive pressure drop under load vacuum conditions
- B. The fuel pump for insufficient volume output under the high fuel demand of wide-open throttle acceleration
- C. The fuel filter for a restriction that allows correct idle pressure but limits volume under load demand
- D. The fuel return line for a partial restriction reducing available return flow and back-pressuring the rail under load

24. A scan tool shows TPS reading 0.52 volts at idle and 4.48 volts at WOT. At approximately 30% throttle opening, the TPS voltage drops suddenly from 1.8 volts to 0.3 volts then jumps back. This happens at the same throttle position every time. What is the MOST likely cause?

- A. A loose TPS connector that separates at a specific throttle angle from harness binding
- B. A TPS reference voltage that drops at mid-throttle from a PCM 5-volt reference circuit fault
- C. A worn or damaged spot on the TPS resistive element or a faulty wiper contact at that specific throttle angle
- D. A throttle body carbon deposit at that position causing a mechanical resistance that the TPS registers as a signal drop

25. A GDI engine has a P0087 fuel rail pressure low code. Low-pressure pump output is 60 psi at the high-pressure pump inlet — within specification. The high-pressure rail reads 300 psi at idle against a 500 psi minimum specification. Commanding the high-pressure pump to maximum output via scan tool raises rail pressure to only 320 psi. What is the MOST likely cause?

- A. A high-pressure pump with worn internal components unable to achieve specification pressure despite a correct low-pressure supply and maximum output command
- B. A high-pressure rail pressure sensor reading low — commanding maximum pump output without pressure change confirms a sensor fault

C. A high-pressure fuel injector stuck open bleeding all rail pressure continuously regardless of pump output

D. A high-pressure pump inlet check valve failure allowing reverse flow and limiting achievable rail pressure

26. An engine has LTFT at +2% on both banks at idle. At highway cruise, LTFT on both banks drops to -14% for approximately 4 minutes and returns to +2%. This pattern is consistent and repeatable. No codes are stored. What is the MOST appropriate conclusion?

A. A MAF sensor that over-reads at highway cruise airflow rates causing the PCM to add fuel and then over-correct

B. A fuel pressure increase at highway speed causing temporary over-delivery before the system compensates and normalizes

C. An exhaust manifold leak that seals at highway speed from thermal expansion causing the trims to shift negative

D. Normal EVAP purge operation — the purge solenoid opening at highway cruise adds canister vapor causing temporary negative trim correction

27. A turbocharged engine has a boost pressure that increases correctly to 14 psi at moderate RPM but continues rising to 22 psi at high RPM with no PCM command for elevated boost. The wastegate solenoid is confirmed functional. What is the MOST likely cause?

A. The boost pressure sensor is reading low — the PCM believes boost is lower than actual and continues adding solenoid command

B. The wastegate actuator diaphragm has ruptured — the solenoid is commanding correctly but the actuator cannot respond to hold the wastegate closed at specification

C. The turbocharger is overspeeding from a faulty wastegate that has seized fully closed and cannot open under any exhaust pressure

D. The PCM boost control calibration has a high-RPM fault commanding elevated boost above the normal specification limit

28. A fuel pressure test at idle shows correct pressure. Under a sustained WOT dyno pull lasting 15 seconds, pressure drops progressively from 58 psi to 29 psi over the final 8 seconds. After the pull, pressure recovers immediately to 58 psi. No vapor or aeration is visible in the fuel system. What is the MOST likely cause?

- A. A fuel pump that is thermally marginal and drops output after extended high-demand operation
- B. A fuel filter that restricts volume under the sustained high-flow demands of extended WOT operation
- C. A partially clogged fuel pump inlet screen restricting fuel volume to the pump specifically under sustained high-demand operation
- D. A fuel pressure regulator that drifts open under sustained high-flow conditions reducing rail pressure progressively

29. An engine has a P0102 MAF sensor low input code. The MAF signal voltage at idle is 0.4 volts against a 0.9–1.1 volt specification. LTFT is +28% on both banks. The air filter is confirmed clean. What should the technician check NEXT?

- A. The MAF sensor signal wire for a high-resistance fault between the sensor and the PCM input reducing the voltage at the PCM
- B. The MAF sensor for contamination on the hot-wire element causing a false low voltage output at all airflow levels
- C. The MAF sensor ground circuit for high resistance causing the sensor output voltage to be pulled low at the PCM
- D. The intake system for an air leak downstream of the MAF sensor adding unmetered air and causing the lean LTFT correction

30. A vehicle has elevated backpressure of 6.2 psi at 2,500 RPM against a 3.0 psi maximum specification. Power under load is significantly reduced. Idle quality is normal. The catalytic converter is confirmed intact externally. What should the technician verify BEFORE condemning the catalytic converter as the restriction source?

- A. The oxygen sensor bung plugs for accidental blockage after recent O2 sensor service
- B. The muffler and resonator for an internal collapse that could be generating the measured backpressure

- C. The exhaust manifold for a casting crack causing partial restriction upstream of the backpressure test point
- D. The catalytic converter inlet pipe for a dent or kink from a road impact that is causing the restriction ahead of the converter body

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

31. A PCV system inspection finds the PCV valve has no rattle when shaken. Manifold vacuum is confirmed at 18 in/Hg at the PCV port. The fresh air inlet is confirmed unobstructed. What is the correct next step?

- A. Replace the intake manifold PCV port fitting — a high vacuum reading confirms the port is clear but the fitting may be restricting flow
- B. Replace the PCV valve — a valve that does not rattle is stuck and cannot regulate crankcase ventilation flow
- C. Clean the PCV hose for carbon deposits that may be restricting flow despite the valve appearing stuck
- D. Confirm crankcase pressure before replacing the PCV valve — a stuck-closed valve may still be allowing some limited flow

32. A vehicle has a P0300 random misfire. Fuel trims are -1% on both banks. A tailpipe HC reading is significantly elevated. Compression and leakage are confirmed normal on all cylinders. A cylinder contribution test shows all cylinders contributing equally within 10 RPM of each other. What should the technician check NEXT?

- A. The fuel injectors for simultaneous lean restriction causing misfires on all cylinders equally
- B. The head gaskets for simultaneous bilateral failure causing equal combustion contamination
- C. The ignition system for a fault causing sub-threshold misfires — equal contribution with elevated HC and neutral trims suggests combustion quality rather than delivery fault
- D. The catalytic converter for reduced efficiency allowing HC to pass through despite confirmed combustion events on all cylinders

33. A P0455 large EVAP leak code is stored. A fuel cap test confirms correct cap sealing. A smoke test with the vent solenoid commanded closed reveals a large smoke plume from the fresh air vent tube on the charcoal canister. What does smoke exiting the vent tube confirm?

- A. The charcoal canister vent solenoid is not fully closing — smoke is escaping through the vent path that should be sealed during the test
- B. The charcoal canister has a cracked housing allowing smoke to bypass the canister body and exit through the vent tube
- C. Normal behavior — the vent tube is the designed escape path for smoke during testing and does not indicate a fault
- D. The EVAP purge solenoid is stuck open drawing smoke through the canister from the purge side rather than the vent side

34. A vehicle has a P0401 EGR insufficient flow code. The EGR valve is commanded open via bi-directional test and the valve actuates. Manifold vacuum drops slightly when the valve opens at idle. A DPFE sensor test shows the sensor voltage changes correctly in response to EGR flow. What should the technician check NEXT?

- A. The EGR valve for a fault preventing full opening despite confirmed mechanical actuation
- B. The DPFE sensor for a calibration drift causing under-reporting of actual EGR flow
- C. The EGR passages in the intake manifold for carbon deposits restricting actual gas flow despite confirmed valve operation
- D. The PCM EGR monitor calibration for a threshold requiring greater flow than this system can produce

34. P0401 EGR insufficient flow. EGR valve actuates on bi-directional test. Vacuum drops slightly at idle when commanded open. DPFE sensor voltage changes correctly. What should the technician check NEXT?

- A. The EGR valve for a fault preventing full opening despite confirmed actuation
- B. The DPFE sensor for calibration drift causing under-reporting of flow
- C. The EGR passages for carbon deposits restricting gas flow despite confirmed valve operation

D. The PCM EGR monitor threshold calibration

35. A vehicle has a P0138 downstream O₂ sensor high voltage code on bank 1. The sensor reads a fixed 0.87–0.92 volts at all operating conditions. The upstream sensor is switching normally with LTFT at +1% on bank 1. The catalytic converter passes a backpressure test. What is the MOST likely cause?

- A. The catalytic converter on bank 1 has lost efficiency — the downstream sensor correctly reflects a rich exhaust exiting a degraded converter
- B. The bank 1 downstream O₂ sensor has a failed sensing element biased toward the rich voltage range and is outputting a fixed high voltage independent of actual exhaust content
- C. An exhaust manifold leak downstream of the catalytic converter is introducing oxygen that paradoxically elevates the sensor voltage
- D. The upstream sensor contamination is causing incorrect fuel trim that is producing a rich exhaust past the converter

36. An AIR system cold start test shows the pump running normally. The upstream O₂ sensor on bank 1 shows no response during the full 30-second pump run. The upstream O₂ sensor on bank 2 shows a strong lean response for the full 30 seconds. What does the absence of a lean response on bank 1 indicate?

- A. The bank 1 upstream O₂ sensor heater is activating too quickly, bringing the sensor to operating temperature before the AIR test window is complete
- B. A weak pump output specifically affecting the bank 1 delivery circuit while providing adequate flow to bank 2
- C. A blocked AIR distribution tube, failed check valve, or disconnected hose preventing air from reaching the bank 1 exhaust ports despite confirmed pump operation
- D. The bank 1 upstream O₂ sensor has failed and cannot detect the lean signal even if air is being delivered correctly

37. A vehicle has a P0420 code. The downstream O₂ sensor on bank 1 switches at 0.95 cycles per second. The upstream O₂ sensor switches at 1.0 cycle per second. LTFT is +2% on bank 1. Backpressure is 1.4 psi at 2,500 RPM. What is the correct interpretation?

- A. The slight switching rate difference confirms marginal catalyst efficiency — the converter should be monitored at the next service before deciding on replacement
- B. The downstream sensor switching faster than expected for a good converter but slightly slower than upstream suggests the sensor is slow rather than the converter failed
- C. A slow downstream O₂ sensor response speed is mimicking catalyst failure — P0133 should be checked and the upstream sensor evaluated before condemning the converter
- D. The downstream sensor switching rate of 0.95 cycles per second against the upstream rate of 1.0 cycle per second confirms the catalyst has insufficient oxygen storage capacity and requires replacement

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

38. A scan tool shows STFT at +1% and LTFT at +2% on both banks at idle. At 2,500 RPM, STFT drops to 0% and LTFT stabilizes at +1%. No codes are stored. All monitors are complete. What is the correct interpretation?

- A. The fuel control system is functioning correctly — fuel trims within $\pm 5\%$ on both banks at all RPM with complete monitors and no codes confirms normal operation
- B. A minor vacuum leak is present — the idle-biased positive trims are a diagnostic indicator requiring smoke testing
- C. The MAF sensor is reading slightly low at idle — idle-biased positive trims always indicate MAF contamination
- D. A borderline injector restriction is present — the RPM-dependent trim change suggests a flow-rate fault developing

39. A vehicle has a P0175 rich code on bank 2. LTFT bank 2 is -19% and LTFT bank 1 is +1%. Bank 2 injectors pass a balance test within 2%. Fuel pressure is correct. A bi-directional test commanding all bank 2 injectors off causes LTFT to move from -19% toward zero within 20 seconds. What does this confirm?

- A. The bank 2 upstream O₂ sensor is contaminated and outputting a false rich signal — the injector disable test eliminates fuel as the variable

- B. The EVAP purge solenoid is preferentially delivering vapor to bank 2 — disabling the injectors reveals the vapor contribution
- C. One or more bank 2 injectors are leaking fuel into the cylinders even when electrically commanded off — the LTFT recovery with injectors disabled confirms the injectors as the fuel source
- D. The bank 2 fuel pressure regulator has a vacuum reference fault — injector disable reduces rail pressure and reveals the regulator fault

40. A vehicle has STFT oscillating between +14% and -14% at 2–3 cycles per second at idle on both banks simultaneously. LTFT is +1% on both banks. No codes are stored. What does this rapid bilateral STFT oscillation MOST likely indicate?

- A. A contaminated upstream O₂ sensor on both banks simultaneously producing erratic voltage output
- B. Normal aggressive closed-loop fuel control hunting from a minor vacuum leak that is at the threshold of LTFT correction
- C. A MAF sensor producing a fluctuating output signal causing the PCM to rapidly cycle fuel delivery
- D. An EVAP purge solenoid cycling rapidly at idle, alternately adding and removing vapor in a rapid oscillation

41. A vehicle has a P0128 coolant below thermostat regulation code. ECT reads 172°F after 25 minutes of highway driving. The thermostat was replaced 1 week ago. A scan tool live data test shows the cooling fan running continuously at all times regardless of coolant temperature. What is the MOST likely cause?

- A. A faulty replacement thermostat — a second consecutive thermostat failure is confirmed by the persistent low temperature reading
- B. A failed ECT sensor reading low — causing both the low temperature indication and the fan running continuously
- C. A coolant temperature too low for the fan to cycle off — the thermostat is keeping temperature low and the fan runs from the low ECT
- D. A cooling fan relay or PCM fan control circuit fault commanding the fan on continuously and overcooling the engine

42. A vehicle has a P0507 idle control system high RPM code. Idle speed is 1,350 RPM with a specification of 650–750 RPM. The IAC valve is replaced and the code recurs within 30 minutes. What should the technician check NEXT?

- A. A vacuum leak providing uncontrolled airflow that bypasses the IAC and raises idle speed above specification regardless of IAC command
- B. The PCM for a fault incorrectly commanding elevated idle speed through the IAC despite the correct valve replacement
- C. The throttle body bore for a carbon deposit partially blocking the IAC passage and causing the PCM to over-command idle air
- D. The throttle plate for a physical binding condition that prevents it from fully closing and allows excess air past the plate

43. A vehicle has an intermittent stall at idle with no stored codes. A scan tool captures the stall event in a freeze frame. The freeze frame shows RPM dropping to zero, ECT at 195°F, MAF at 0.0 g/s, and TPS at 0.49 volts at the moment of stall. All sensors read normal immediately before the stall. What does the simultaneous loss of RPM and MAF at the stall event with normal TPS indicate?

- A. The TPS reading confirms a sudden throttle closure caused the stall — the 0.49 volt reading indicates a closed throttle event
- B. A fuel delivery failure at the stall moment — MAF drops to zero because the engine stopped receiving fuel
- C. The engine stalled from a sudden loss of the CKP or CMP signal — MAF drops to zero because the engine stopped running and airflow ceased simultaneously
- D. The MAF sensor failed at the stall moment — zero MAF with running RPM would indicate a sensor fault, but zero RPM and zero MAF together indicate an engine stop

44. A vehicle has LTFT at +22% on bank 1 and +3% on bank 2 at idle. At 2,500 RPM, bank 1 LTFT drops to +6% and bank 2 LTFT remains at +3%. A smoke test of the bank 1 intake reveals no vacuum leaks. Fuel pressure is correct and all bank 1 injectors pass a balance test. What should the technician check NEXT?

- A. The bank 1 upstream O2 sensor for contamination producing false lean corrections at idle only
- B. An exhaust manifold leak on bank 1 upstream of the O2 sensor introducing oxygen and causing false lean fuel trim correction
- C. The MAF sensor for a contamination fault causing selective lean delivery to bank 1 at idle
- D. A vacuum leak on the bank 1 side that was not detected by the standard smoke test — a low-pressure test should be performed

45. A vehicle fails an OBD II readiness inspection. The scan tool shows the catalyst monitor and EVAP monitor as incomplete. All other monitors are complete. No codes are stored. The battery was replaced 3 weeks ago and the vehicle has been driven 250 miles. What is the MOST likely reason both specific monitors remain incomplete?

- A. A pending O2 sensor fault is preventing both downstream monitors from completing without setting a confirmed code
- B. The vehicle needs a specific manufacturer-defined drive cycle performed to simultaneously enable both the catalyst and EVAP monitors within the same drive event
- C. A minor EVAP system seep below the P0442 threshold is preventing the EVAP monitor from passing and blocking the catalyst monitor as a dependency
- D. Both monitors require the vehicle to be at full operating temperature for a minimum of 45 minutes continuously — the 250-mile drive total is insufficient duration

45. After a battery replacement 3 weeks ago and 250 miles of driving, catalyst and EVAP monitors remain incomplete. All other monitors are complete. No codes are stored. What is the MOST likely reason?

- A. A pending O2 sensor fault is blocking both monitors from completing
- B. A specific manufacturer drive cycle with defined enable conditions for both monitors has not been completed
- C. A minor EVAP seep below code threshold is blocking the EVAP monitor and the catalyst monitor as a dependency
- D. Both monitors require 45 continuous minutes at full operating temperature that the 250-mile total has not provided

46. A vehicle has a P0340 CMP sensor no signal code. Supply voltage is confirmed at 5 volts. Ground resistance is 0.1 ohms. A lab scope during cranking shows the signal wire reading 5 volts continuously — it never switches low. A known-good CMP sensor is installed and the signal immediately begins switching correctly. What does the original failure pattern confirm?

A. The original CMP sensor's internal Hall effect element failed — it could not switch its output low despite correct supply voltage and ground, indicating an open internal switch

B. The trigger wheel had a fault preventing the Hall element from activating — the new sensor functions because of its different sensitivity threshold

C. The PCM CMP input circuit had a pull-up resistor fault holding the signal high — the new sensor worked because it has lower output resistance

D. The signal wire had a short to the 5-volt reference that was corrected during the sensor replacement procedure

47. A vehicle has LTFT at +3% on both banks at idle. A road test shows idle and city driving LTFT remain near +3%. During sustained highway cruise, the LTFT on both banks climbs to +18% and stays elevated until the vehicle returns to city speeds. What does the RPM and load-dependent lean condition MOST likely indicate?

A. A vacuum leak that is only present under the high manifold vacuum of highway cruise light-throttle conditions

B. A clogged fuel filter restricting pump output volume under the sustained high-flow demands of highway cruise operation

C. A MAF sensor that reads correctly at low airflow rates but progressively underreads as airflow increases toward highway cruise levels

D. A fuel pump that thermally degrades under sustained highway operation reducing output volume and rail pressure

48. A vehicle has all OBD II monitors complete with no stored codes. Mode 6 data for the upstream O2 sensor response test on bank 1 shows a response time of 680 milliseconds against a maximum allowed threshold of 700 milliseconds. What is the MOST appropriate action?

- A. Replace the bank 1 upstream O2 sensor immediately — a response time above 500 ms always indicates imminent failure
- B. Note the finding and inform the customer — the monitor passed but the sensor is approaching its response time threshold and should be monitored at the next service
- C. Perform a rich-lean and lean-rich response time test using a scan tool to confirm the Mode 6 finding before any action
- D. No action required — the Mode 6 result is a pass and the value has no actionable significance until a P0133 code is set

49. A vehicle has a P0300 random misfire, P0171 bank 1 lean, and P0174 bank 2 lean stored simultaneously. LTFT is +23% on both banks at idle. A smoke test reveals no vacuum leaks. Fuel pressure is 57 psi. MAF reads 2.1 g/s against a 4.5–6.0 g/s idle specification. What is the MOST likely cause?

- A. A simultaneous lean vacuum leak on both banks that the smoke test failed to detect — requires a low-pressure smoke test
- B. A fuel pump unable to maintain adequate pressure under demand — the P0300 and lean codes confirm fuel starvation
- C. Leaking injectors on all cylinders simultaneously causing the PCM to over-correct with positive fuel trims
- D. A MAF sensor significantly underreporting actual airflow — the 2.1 g/s reading at less than half the idle specification is the primary cause of both lean codes and the misfire

50. A vehicle with a 4-cylinder engine has STFT at +2% and LTFT at +3% at idle. At 1,500 RPM, LTFT suddenly drops to -15% on both banks and stays there until RPM drops back to idle. No codes are stored. The EVAP system purge is confirmed inactive at 1,500 RPM during testing. What is the MOST likely cause?

A. A MAF sensor that reads correctly at idle but significantly over-reads above a specific RPM threshold, causing the PCM to remove fuel above that RPM

B. A fuel pressure increase at 1,500 RPM from a return line restriction causing over-delivery above idle

C. An exhaust manifold leak that opens specifically above idle RPM from thermal and pressure changes

D. A vacuum leak that seals at 1,500 RPM from aerodynamic pressure equalizing the manifold vacuum to atmospheric

PRACTICE EXAM 16: ANSWER KEY AND EXPLANATIONS

DOMAIN A — GENERAL DIAGNOSIS

1. **B. A sticking valve that seats inconsistently** — A vacuum needle that floats erratically between 14 and 20 in/Hg at an irregular, unpredictable interval with stable RPM is the defining pattern of a valve that sticks open intermittently. Each time the valve sticks open, the cylinder fails to seal during compression and exhaust strokes, allowing manifold pressure to equalize briefly and dropping the vacuum reading. When the valve reseats, the cylinder resumes normal pumping and the needle recovers. The irregular interval — not tied to any specific RPM relationship — distinguishes this from a consistent single-cylinder misfire, which would drop the needle at a fixed, speed-proportional interval. Retarded timing produces a steady low reading without erratic fluctuation, and vacuum leaks produce a consistently low steady reading rather than erratic swings between two values.
2. **D. A burned or damaged valve on cylinder 3** — Cylinder 3 reads 160 psi dry — within the range of all other cylinders — but the wet test produces only a 1 psi improvement. This near-zero wet test response is the critical finding. When compression is low from worn rings, oil introduced during the wet test temporarily seals the ring gap and produces a measurable improvement — typically 15 psi or more. A burned or leaking valve produces low or no wet test response because oil pooled on top of the piston cannot reach or seal the valve face where the leak is occurring. In this case the compression is not severely low, but the complete absence of wet test improvement with a borderline reading confirms a valve sealing fault rather than a ring fault.
3. **A. Detonation or spark knock** — A knock that is present at idle, intensifies under load, and can be temporarily eliminated or reduced by retarding ignition timing is the clinical presentation of spark knock or detonation. Detonation is an abnormal combustion event driven by excess ignition advance — the air-fuel mixture auto-ignites before the spark event under the high pressure and temperature of the compression stroke. Retarding timing delays the combustion event relative to piston position, reducing peak cylinder pressure and temperature and temporarily suppressing the auto-ignition tendency. Load sensitivity confirms detonation — higher load increases cylinder pressure and temperature, lowering the detonation threshold. Worn bearing knock is load-sensitive but is entirely unaffected by timing changes.
4. **C. A leaking exhaust valve on cylinder 6** — Air escaping exclusively from the exhaust pipe during a cylinder leakage test on cylinder 6 confirms the test air is passing directly through the exhaust valve face into the exhaust manifold and out the tailpipe. The exhaust valve is the only

seal between the combustion chamber and the exhaust system — a burned, warped, or insufficiently seated exhaust valve allows pressurized test air to flow past the valve face along the exact path it would take if the valve were open. No other failure routes test air exclusively to the exhaust outlet. Worn rings route air to the crankcase, an intake valve leak routes air to the throttle body, and a head gasket breach typically routes air to either the cooling system or an adjacent cylinder — not exclusively to the exhaust pipe.

5. **B. A head gasket failure or cracked head allowing coolant to enter the combustion chamber** — White smoke with a sweet smell that persists after full warm-up combined with dropping coolant level is the definitive presentation of coolant entering the combustion chamber and being vaporized during combustion. Normal condensation produces white vapor only during cold start that clears completely once the exhaust system reaches operating temperature. The sweet smell distinguishes coolant vapor from water vapor — ethylene glycol has a characteristic sweet odor when burned. Persistent white smoke after full warm-up confirms the coolant source is continuous rather than residual condensation, and the dropping coolant level confirms coolant is being consumed. A failed head gasket allowing combustion-to-coolant communication is the most common mechanism for this presentation.
6. **D. The heater core for an internal leak draining into the HVAC housing** — A pressure test performed at operating temperature that holds for 5 minutes then drops 1 psi per minute confirms a slow, temperature-dependent leak that is not present when cold. No external drips eliminate an external source, and normal oil appearance eliminates a head gasket breach communicating with the oil passages. A heater core internal leak allows hot pressurized coolant to seep from the core tubes into the HVAC housing, where it drips or evaporates inside the dashboard with no visible external evidence. The temperature-dependent onset — the test held when cold pressure is first applied but begins dropping as the system remains at full temperature — is consistent with a heater core joint or tube that only weeps under sustained thermal and pressure stress.
7. **C. Carbon buildup on the cylinder 8 piston or head raising effective compression** — All other cylinders show consistent crank speed and amperage, confirming the test is running correctly and baseline values are valid. Cylinder 8 shows normal average crank speed — confirming the cylinder is not mechanically binding — but a brief amperage spike at exactly one point per revolution indicates the starter encounters extra resistance at a specific crankshaft position corresponding to cylinder 8's compression stroke. Carbon deposits accumulating on the piston crown or combustion chamber ceiling reduce the clearance volume, raising the effective compression ratio and creating a higher-than-normal pressure peak during compression. This increased compression resistance manifests as a brief spike in starter current demand at that specific rotational position on every revolution.
8. **A. Piston-to-bore clearance that is excessive when cold** — A knock present only when cold that disappears completely and permanently after 2–3 minutes of warm-up at all RPM and loads is the defining pattern of cold piston slap from excessive bore clearance. Aluminum pistons have a higher

coefficient of thermal expansion than the cast iron or aluminum cylinder bores they operate in. When cold, the pistons are dimensionally smaller than their operating diameter, creating measurable clearance that allows the piston to rock laterally — producing the characteristic hollow slapping sound. After 2–3 minutes of operation, the aluminum pistons expand thermally to their operating diameter, taking up the excess clearance and silencing the knock completely at all RPM and load conditions. Normal oil pressure eliminates bearing knock, which would typically persist or worsen with temperature.

9. **B. Worn valve stem seals allowing oil to be drawn in under closed-throttle deceleration vacuum** — Blue smoke exclusively during closed-throttle deceleration from highway speed with no smoke at idle, acceleration, or cruise is the specific pattern of worn valve stem seals responding to the extreme intake vacuum present during engine braking. Closed-throttle deceleration from highway speed creates the highest sustained intake manifold vacuum of any normal operating condition — the throttle is completely closed while the engine is being turned at elevated RPM by the vehicle's momentum. This extreme vacuum draws oil past degraded valve stem seals at a rate much higher than the moderate vacuum present at idle, producing the visible blue smoke specifically during that operating phase. Normal compression eliminates ring wear, which would produce smoke under acceleration rather than exclusively during deceleration.
10. **D. The cylinder 2 injector circuit for an open or high-resistance fault causing minimal fuel delivery** — A cylinder contribution test showing cylinder 2 dropping only 40 RPM compared to 190–210 RPM on all other cylinders confirms cylinder 2 is contributing almost no power — it is misfiring on virtually every firing event. With no stored codes directing the diagnosis to ignition or mechanical faults, and with the dramatic disparity in contribution pointing to near-zero combustion rather than a partial fault, the most likely cause is a fuel delivery circuit failure that is preventing fuel from reaching that cylinder on every cycle. An open or high-resistance injector circuit — a fault in the injector wiring, connector, or PCM driver — produces no fuel delivery and near-zero contribution without necessarily setting a code if the fault is intermittent or below the misfire detection threshold at the time of the contribution test.
11. **C. A clogged or restricted catalytic converter building backpressure progressively** — Normal vacuum at the start of the sustained RPM period confirms the engine is healthy under brief elevated RPM. The progressive collapse from 20 in/Hg to 6 in/Hg over 8 seconds of sustained 2,500 RPM — followed by immediate recovery when RPM is reduced — is the defining pattern of exhaust restriction under sustained elevated flow. As RPM is held elevated, exhaust volume increases and the restriction builds backpressure progressively behind the blockage. This increasing backpressure opposes the engine's ability to expel exhaust and draw in fresh charge, progressively collapsing intake vacuum. When RPM is reduced and exhaust flow drops below the restriction threshold, backpressure dissipates and vacuum recovers immediately. The progressive nature distinguishes restriction from a timing or valve fault, which would cause an immediate rather than gradual vacuum collapse.

12. **A. The rotor for a carbon tracking fault allowing secondary voltage to short inside the cap** — Spark is confirmed at the coil wire — confirming the ignition coil is generating high voltage and delivering it to the distributor cap center terminal. The absence of spark at all plug wires with a visually normal cap and rotor indicates the high voltage is entering the cap but not being distributed to any terminal. A rotor with internal carbon tracking — a conductive carbon path formed across the rotor body — allows high voltage arriving at the rotor center to short directly to the rotor's metal shaft and ground rather than arcing across the air gap to the cap terminals. This routes all secondary voltage to ground inside the cap, producing confirmed coil output with zero spark at all plug wires. The fault is not visible on external rotor inspection because the carbon track is on the internal rotor body surface.

DOMAIN B — IGNITION SYSTEM DIAGNOSIS AND REPAIR

13. **B. Normal wear at or beyond the recommended service interval** — Rounded center and ground electrodes with a noticeably wider gap on a high-mileage engine, combined with a clean light-gray insulator and no deposits, is the expected appearance of a spark plug that has reached or exceeded its recommended service interval through normal operation. Electrode material erodes gradually with each firing event — center electrode material is ejected by the arc and ground electrode material is eroded by the return arc path, progressively widening the gap and rounding both electrode profiles. The light-gray insulator confirms the plug has been operating at correct temperature with a proper air-fuel mixture throughout its service life. No abnormal damage patterns — no melting, no blistering, no mechanical impact marks — are present to suggest detonation, pre-ignition, or other abnormal combustion events.
14. **D. A failing PCM driver that cannot pull the command wire to near zero** — Supply voltage of 12.3 volts is confirmed at the coil terminal, establishing correct power delivery. The command wire reads 11.9 volts at rest — which is correct, as the wire should rest near battery voltage when the PCM driver transistor is open. When the PCM attempts to fire the coil by grounding the command wire, the voltage drops only to 11.4 volts — a reduction of only 0.5 volts rather than the near-zero drop a functional driver produces. A healthy PCM driver transistor saturates fully when switched on, creating a near-zero resistance path to ground that pulls the command wire to near zero volts. A failing driver transistor that cannot saturate produces a partial voltage drop — it is attempting to ground the circuit but has insufficient drive capability, resulting in the 11.4-volt residual and no spark production.
15. **C. A spark plug with a wider-than-normal gap on the high-firing-line cylinder** — On a waste spark coil, both cylinders in the pair share the same coil energy — the total secondary voltage is distributed between the two spark plug gaps in series. A plug gapped wider than specification on one cylinder of the pair requires more voltage to initiate the arc across its larger gap, consuming a greater share of the total available secondary energy for that firing event. This produces a visibly higher firing line on the wide-gap cylinder relative to its paired cylinder. The absence of a misfire code confirms the gap is wider than normal but not wide enough to prevent firing — the coil is

producing sufficient energy to fire both cylinders, but the voltage split is uneven. The correct next step is to measure the gap on the high-firing-line cylinder and compare it to specification.

16. **A. A Hall effect sensor with a temperature-sensitive internal circuit element** — Supply voltage and ground are both confirmed correct at all temperatures, eliminating external circuit faults as the cause. At normal operating temperatures the signal switches cleanly between 0 and 5 volts, confirming correct sensor operation when warm. The intermittent signal sticking at 5 volts for 0.3–0.5 seconds specifically during cold ambient testing at 20°F identifies a temperature-dependent internal failure within the sensor itself. The Hall effect integrated circuit contains a switching transistor that pulls the output low when triggered — a transistor or internal component with temperature-sensitive characteristics can lose its ability to switch low intermittently at extreme cold temperatures. The symptom's direct correlation with cold ambient temperature and confirmed correct external circuit operation confirms the fault is internal to the sensor.
17. **B. The cylinder 1 coil boot seating on the newly installed spark plug** — The tune-up is the direct preceding event, making installation errors the first diagnostic consideration before pursuing component faults. On a DIS waste spark system, a P0301 misfire on cylinder 1 only — with no P0304 on its coil partner — suggests a fault that is specific to the cylinder 1 side of the coil circuit rather than the coil itself, which would affect both paired cylinders. A coil boot that is not fully seated on the newly installed cylinder 1 spark plug creates an air gap in the secondary circuit at the plug connection point. This gap causes the high voltage to arc through the boot insulation rather than across the plug gap, producing a cylinder 1 misfire while cylinder 4 — whose boot and plug connection are correct — fires normally on the same coil.
18. **D. A missing tooth on the reluctor wheel at that position** — A magnetic reluctance sensor generates voltage through electromagnetic induction as each tooth passes through its magnetic field. The normal reference gap — the engineered missing tooth position — produces a dropout to zero because no tooth passes to create a field change. A large positive voltage spike at that specific position every revolution is the characteristic signature of a metallic debris particle or fragment that has lodged at the reference gap position. The metallic debris acts as an artificial tooth, generating a field change as it passes the sensor and producing a positive voltage spike where none should exist. Unlike the surrounding teeth that produce consistent symmetrical waveforms, the debris-induced spike is typically asymmetrical or different in shape from normal tooth signals, helping confirm the diagnosis.
19. **C. Both coils from cylinders 3 and 7 have failed** — Both coils are individually swapped from their original positions to confirmed-good positions. Both misfires move with their respective coils — P0303 and P0307 disappear from cylinders 3 and 7 and new misfire codes appear at the positions where the suspect coils were moved. This confirms each fault traveled with its coil to the new location. The subsequent spark plug swap does not move the misfires back — confirming the plugs are not contributing to either misfire. Two independent coil failures occurring simultaneously is unusual but can occur from shared causes such as a common power supply voltage spike,

prolonged overheating from a previous misfire event, or age-related simultaneous failure on high-mileage vehicles. The systematic swap testing definitively rules out PCM drivers, plug wires, and spark plugs on both cylinders.

20. **B. The coil primary winding has a short circuit** — A DVOM reading of 0.0 ohms on a coil primary winding with a specification of 0.7–1.3 ohms indicates the resistance is below the minimum by a significant margin — not within the lower end of specification. A 0.0 ohm reading means there is essentially no resistance between the two primary winding terminals — the winding is shorted internally, with turns of wire contacting each other and bypassing the designed resistance of the full winding. A shorted primary winding allows excessive current to flow during dwell, potentially damaging the PCM output driver over time, and reduces the magnetic field intensity because the winding's effective turn count is reduced. A DVOM zeroing issue produces a reading of 0.0 on an open circuit — on a resistance test with the leads shorted to each other — not on a component that should show measurable resistance.

DOMAIN C — FUEL, AIR INDUCTION, AND EXHAUST SYSTEMS

21. **A. The fuel pump check valve is intact — pressure holds with the supply pinched, confirming the leak is downstream through the injectors** — Key-on pressure of 58 psi drops to 12 psi over 30 minutes with the return line unobstructed, identifying a significant leak path. Pinching the fuel supply line at the rail and observing that pressure holds at 55 psi over 30 minutes — rather than continuing to drop — isolates the leak path. With the supply line pinched, fuel cannot flow backward through the pump regardless of check valve condition. Pressure holding with the supply pinched confirms no leak exists between the supply pinch point and the test gauge — meaning the pump and its check valve are not the drain-back source. The pressure loss when the supply is open but not when it is pinched confirms the fuel is leaking forward through one or more injectors with slight internal seepage that accumulates over 30 minutes.
22. **D. LTFT of -2% and -1% are within the ±10% normal operating range** — Short and long-term fuel trims of -2% and -1% on both banks at all engine speeds represent minimal fuel corrections well within the universally accepted normal operating range. These values confirm the PCM is making only very small reductions to base fuel delivery — indicating the air-fuel metering system has no significant fault producing a persistent lean or rich condition requiring large corrections. The bilateral symmetry across both banks at all RPM ranges confirms no bank-specific or speed-specific fault is present. Near-zero negative trims are as normal and acceptable as near-zero positive trims — neither direction requires investigation unless the magnitude approaches or exceeds the ±10% diagnostic threshold.
23. **B. The fuel pump for insufficient volume output under wide-open throttle demand** — Idle pressure of 57 psi with the vacuum line disconnected confirms adequate pump output at low fuel demand. The vacuum-referenced pressure drop to 51 psi — within the expected 6–8 psi range — confirms the regulator is functioning correctly. Under hard acceleration and WOT, fuel demand increases dramatically as injector pulse width widens to deliver maximum fuel volume. Pressure

dropping to 38 psi — 12 psi below the 50 psi minimum — confirms the pump cannot maintain adequate rail pressure under the high volume demand of WOT. A pump with worn brushes, a partially blocked inlet screen, or reduced armature output can maintain correct idle pressure at low demand but cannot sustain adequate flow volume when WOT pulse widths require maximum delivery, causing rail pressure to collapse under load.

24. **C. A worn or damaged spot on the TPS resistive element or a faulty wiper contact** — A TPS voltage that reads correctly at idle and WOT but drops suddenly and recovers at a specific intermediate throttle position every time is the definitive pattern of a resistive track fault at that position. The TPS operates as a variable resistor — a wiper contacts a resistive element and moves along it as the throttle opens. A worn spot, a carbon deposit, or a physical crack in the resistive element at a specific angular position causes the wiper to momentarily lose contact or encounter a break in the track, producing the instantaneous voltage drop and recovery seen at that exact throttle angle. The consistent repeatability at the same throttle position confirms a fixed physical fault at a specific location on the resistive element rather than an intermittent electrical connection fault.
25. **A. A high-pressure pump with worn internal components** — Low-pressure supply to the high-pressure pump inlet is confirmed at 60 psi — within specification — confirming the pump has adequate fuel supply. Despite correct low-pressure input, rail pressure is only 300 psi against a 500 psi minimum, and commanding maximum pump output via scan tool raises pressure only to 320 psi — 180 psi below the minimum specification even at commanded maximum. A high-pressure GDI pump with worn plunger seals, worn cam lobe followers, or deteriorated inlet and outlet check valves cannot achieve the designed compression ratio from supply pressure to rail pressure regardless of how aggressively it is commanded. The inability to approach specification even at maximum commanded output, with confirmed correct supply, confirms internal mechanical pump wear as the fault.
26. **D. Normal EVAP purge operation** — LTFT of +2% on both banks at idle confirms the base fuel delivery is slightly lean but well within normal range. The consistent, repeatable bilateral drop to -14% at highway cruise followed by recovery to the baseline +2% is the expected fuel trim signature of the EVAP canister purge cycle activating at cruise conditions. At highway cruise, the PCM commands the purge solenoid open to flow stored fuel vapors from the charcoal canister into the intake manifold. These unmetered vapors add to the existing fuel delivery, temporarily enriching the mixture and causing the PCM to reduce fuel delivery — producing the bilateral negative LTFT excursion. When the purge cycle completes and the solenoid closes, vapor delivery stops and LTFT returns to its normal idle-established baseline.
27. **C. A wastegate seized fully closed that cannot open under any exhaust pressure** — Boost increasing correctly to 14 psi at moderate RPM confirms the turbocharger and boost control system are functioning at lower RPM levels. The continued rise to 22 psi at high RPM despite no PCM command for elevated boost and a confirmed functional solenoid indicates the wastegate cannot open to limit boost regardless of control input. A wastegate that has mechanically seized in the

fully closed position cannot be opened by solenoid command, exhaust pressure, or any other input — the turbine wheel accelerates unconstrained by wastegate regulation as exhaust energy increases with RPM, allowing boost to rise continuously beyond the commanded limit. The progressive RPM-related rise rather than a sudden step change is consistent with the unconstrained turbine acceleration pattern of a fully seized-closed wastegate.

28. **C. A partially clogged fuel pump inlet screen restricting volume under sustained high-demand operation** — Correct idle pressure and correct brief WOT pressure confirm the pump generates adequate pressure and volume under low-demand and momentary high-demand conditions. The progressive pressure drop specifically during a sustained 15-second WOT pull — not during brief acceleration — points to a volume restriction that only manifests under sustained maximum flow demand rather than brief peak demand. A partially clogged pump inlet screen allows adequate fuel volume at idle and momentary WOT but cannot sustain the high flow rate required during extended maximum demand. As the screen's restriction depletes the fuel available to the pump inlet under sustained high demand, pressure drops progressively. The immediate recovery confirms the pump itself is functional — only the inlet supply is restricted.
29. **A. The MAF sensor signal wire for a high-resistance fault** — MAF signal voltage of 0.4 volts against a 0.9–1.1 volt specification with LTFT at +28% confirms the PCM is receiving a significantly low MAF signal and compensating heavily for the resulting calculated lean condition. The air filter is confirmed clean, eliminating restricted airflow as the cause. A high-resistance fault in the signal wire between the MAF sensor and the PCM input reduces the voltage level the PCM receives relative to the sensor's actual output — the sensor may be generating a correct signal that is being attenuated before reaching the PCM input. This is distinct from a contaminated sensor, which produces a low signal at the sensor itself. Testing voltage directly at the sensor output connector versus the PCM input pin confirms whether the voltage loss is in the wire path.
30. **D. The catalytic converter inlet pipe for a dent or kink from road impact** — Confirmed intact external catalytic converter appearance and elevated backpressure of 6.2 psi at 2,500 RPM — more than double the 3.0 psi maximum — confirms a significant exhaust restriction exists in the system. Before condemning the catalytic converter substrate as the restriction source, the technician should inspect all components upstream of the backpressure test point that could independently cause restriction. The inlet pipe between the exhaust manifold and the converter face is vulnerable to road impact damage — a dent, kink, or partial collapse of the inlet pipe creates a restriction ahead of the converter that produces elevated backpressure readings identical to those generated by a collapsed converter substrate. Confirming or eliminating the inlet pipe as the restriction source before converter replacement prevents an unnecessary repair if the pipe is the actual fault.

DOMAIN D — EMISSIONS CONTROL SYSTEMS

31. **B. Replace the PCV valve — a valve that does not rattle is stuck** — Manifold vacuum is confirmed at 18 in/Hg at the PCV port and the fresh air inlet is confirmed clear — the system has both a functioning vacuum source and an unobstructed air inlet. A PCV valve that does not rattle

when shaken has an internal plunger that is stuck and cannot move to regulate crankcase ventilation flow. A correctly functioning PCV valve contains a spring-loaded plunger that rattles freely when the valve is shaken and modulates flow based on manifold vacuum. A stuck plunger can produce either a stuck-open condition — allowing excessive oil vapor and airflow — or a stuck-closed condition — blocking crankcase ventilation entirely. Either fault requires valve replacement. The confirmed vacuum source and unobstructed inlet confirm the valve itself is the only unconfirmed component in the circuit.

32. **C. The ignition system for a fault causing sub-threshold misfires** — Fuel trims of -1% on both banks confirm no lean mixture fault — the mixture is near stoichiometry with no persistent lean or rich condition. Confirmed normal compression and leakage on all cylinders eliminate mechanical causes. Equal cylinder contribution within 10 RPM confirms no single cylinder is contributing significantly less than others. Elevated tailpipe HC with neutral trims, confirmed normal compression, and equal cylinder contribution describes a situation where combustion is failing on one or more cylinders at a rate below the PCM's misfire detection threshold — often called sub-threshold or marginal misfires. Each misfire event delivers an unburned HC charge to the exhaust without accumulating enough events per monitoring window to set a P030X code, but the cumulative HC delivery produces measurable tailpipe elevation detectable on an emissions analyzer.
33. **A. The charcoal canister vent solenoid is not fully closing** — A large EVAP leak code with a confirmed sealing fuel cap directs the diagnosis to the EVAP system beyond the fuel cap. A smoke test with the vent solenoid commanded closed should produce a sealed system — all smoke introduced through the purge side should remain inside the system if all components are sealing. Smoke exiting the fresh air vent tube on the charcoal canister during a test with the vent solenoid commanded closed confirms the vent solenoid is not fully sealing the vent path as commanded. The vent solenoid may be receiving the command signal correctly but failing to physically close its internal valve — a stuck-open condition or a solenoid with insufficient plunger travel allows smoke to continuously escape through the vent path that should be sealed, producing the large leak code.
34. **D. The PCM EGR monitor threshold calibration** — The EGR valve actuates mechanically on the bi-directional test, confirming it can open. A slight manifold vacuum drop when the valve opens at idle confirms some EGR flow is occurring — the valve is not completely blocked. The DPFE sensor voltage changes correctly in response to the flow, confirming the differential pressure measurement system is functional. With valve actuation confirmed, some flow confirmed, and sensor response confirmed, the system is partially functional. A P0401 insufficient flow code that persists despite confirmed partial system function suggests the PCM's EGR monitor threshold requires a greater flow magnitude — a larger vacuum drop and a larger DPFE voltage change — than the system is currently delivering. Carbon deposits partially restricting the EGR passages would reduce delivered flow volume below the monitor's minimum threshold despite correct valve and sensor operation.

35. **B. The bank 1 downstream O2 sensor has a failed sensing element biased toward the rich voltage range** — The upstream sensor is switching normally with LTFT at +1% — confirming the upstream fuel control and mixture delivery are correct and no actual rich condition exists in the combustion products leaving the engine. The catalytic converter passes a backpressure test, confirming physical integrity. Despite confirmed correct upstream operation and an intact converter, the downstream sensor reads a fixed 0.87–0.92 volts without switching at any operating condition. A sensor that reads a fixed high voltage regardless of actual exhaust composition — even during a commanded lean excursion that should drive it below 0.2 volts — has an electrochemical sensing element that has failed internally with a positive bias. It is outputting a default high voltage independent of exhaust oxygen content rather than responding to the actual exhaust stream.
36. **C. A blocked AIR distribution tube, failed check valve, or disconnected hose on bank 1** — The pump is confirmed running and the bank 2 response is confirmed strong for the full 30 seconds — establishing that the pump is generating adequate air output and the overall system is functioning. Bank 1 shows no lean response at all despite confirmed pump operation and a confirmed responding bank 2 side. With adequate pump output confirmed by bank 2's strong response, the absence of any lean signal on bank 1 confirms air is not reaching the bank 1 exhaust ports. The fault is localized to the bank 1 delivery side — a blocked distribution tube prevents air from exiting at the exhaust ports, a failed check valve blocks the delivery path, or a disconnected hose between the pump output and the bank 1 distribution manifold eliminates delivery entirely despite correct pump operation.
37. **D. The downstream sensor switching at 0.95 cycles per second confirms insufficient oxygen storage capacity and requires replacement** — The downstream sensor is switching at 0.95 cycles per second against an upstream rate of 1.0 cycle per second. A functioning catalytic converter stores and releases oxygen from the exhaust stream, buffering the downstream exhaust composition relative to the constantly switching upstream. This buffering causes the downstream sensor to switch at a significantly slower rate than the upstream sensor — typically several times slower on a healthy converter. A downstream switching rate of 0.95 cycles per second — nearly identical to the upstream rate of 1.0 cycle per second — confirms the converter has lost essentially all of its oxygen storage capacity. With no effective buffering occurring, the downstream sensor mirrors the upstream pattern almost exactly, which is the definitive presentation of a chemically depleted catalyst confirming the P0420 is valid.

DOMAIN E — COMPUTERIZED ENGINE CONTROLS INCLUDING OBD II

38. **A. The fuel control system is functioning correctly** — STFT at +1% and LTFT at +2% at idle dropping to 0% STFT and +1% LTFT at 2,500 RPM represents small, normal fuel corrections well within the accepted $\pm 10\%$ operating range on both banks at all engine speeds. The slight idle-biased positive lean correction at idle that normalizes at elevated RPM is a common normal pattern on many vehicles — minor idle airflow variation from normal IAC function or minor low-airflow

MAF variation that normalizes under higher flow conditions. All monitors complete with no stored codes confirms the OBD II system has evaluated all monitored systems and found no faults. Near-zero bilateral trims, complete monitors, and no codes together confirm the engine management system is operating correctly with no diagnostic action indicated.

39. **C. One or more bank 2 injectors are leaking fuel when electrically commanded off** — All bank 2 injectors pass a balance test within 2% — confirming their electrical operation and commanded delivery volume are correct and equal. Fuel pressure is normal, confirming no pressure fault is causing the rich condition. Despite confirmed correct commanded delivery, LTFT bank 2 is at -19%, indicating the PCM is removing nearly 20% of commanded fuel to maintain stoichiometry — confirming excess fuel is entering the bank 2 cylinders from a source beyond commanded injection. Commanding all bank 2 injectors electrically off via bi-directional test and observing LTFT recover toward zero within 20 seconds confirms the injectors are the source of the excess fuel — at least one injector continues to allow fuel to drip into its cylinder through a leaking needle or seat even when no electrical command is present.
40. **B. Normal aggressive closed-loop fuel control hunting from a minor vacuum leak** — STFT oscillating rapidly between +14% and -14% — completing 2–3 full cycles per second — with LTFT near zero on both banks confirms the PCM is continuously overshooting rich and lean corrections rather than maintaining stable stoichiometry. Near-zero LTFT confirms the average mixture is near stoichiometry — the PCM's long-term correction is nearly zero — but the short-term control is unstable. A minor vacuum leak at the threshold of PCM correction capability introduces a small, constant unmetered air quantity. The closed-loop system responds by adding fuel, overshoots rich, then removes fuel, overshoots lean, creating the rapid oscillation pattern. LTFT remains near zero because the average correction over the oscillation cycle is balanced — only the gain of the closed-loop control is destabilized by the marginal lean input.
41. **D. A cooling fan relay or PCM fan control circuit fault commanding the fan on continuously** — The thermostat was replaced only 1 week ago — making a second consecutive immediate thermostat failure unlikely as the first diagnostic conclusion. ECT reading 172°F after 25 minutes of highway driving is below the thermostat's regulation temperature, confirming the coolant is not reaching normal operating temperature. A cooling fan confirmed running continuously at all times regardless of coolant temperature is the key diagnostic finding — a fan that runs at full speed continuously regardless of ECT input removes heat from the coolant continuously, preventing the coolant from reaching and maintaining the thermostat's regulation temperature. The cooling fan itself — not the thermostat — is the cause of the overcooling and the P0128 code. A relay stuck closed or a PCM fan control circuit fault commanding continuous fan operation is the cause.
42. **A. A vacuum leak providing uncontrolled airflow bypassing the IAC** — Idle speed of 1,350 RPM — nearly double the 650–750 RPM specification — with a newly replaced IAC valve that recurs within 30 minutes confirms the elevated idle is not caused by the IAC hardware itself. A vacuum leak that introduces unmetered air into the intake manifold bypasses the IAC's flow control

entirely — the additional unmeasured air raises idle speed above specification regardless of how correctly the IAC is functioning or how recently it was replaced. The PCM's IAC command reduces IAC airflow toward minimum in an attempt to lower RPM, but it cannot compensate for unmeasured air entering through a vacuum leak. The immediate recurrence after a confirmed good IAC replacement points directly to a cause that is independent of the IAC — a vacuum leak is the most common and most likely cause of this presentation.

43. **C. The engine stalled from a sudden loss of the CKP or CMP signal** — ECT at 195°F confirms a fully warmed engine in normal closed-loop operation. TPS at 0.49 volts confirms a normal closed-throttle idle position — no sudden throttle event caused the stall. MAF at 0.0 g/s at the stall moment confirms airflow through the MAF sensor dropped to zero — which occurs when the engine stops running and the intake air column stops moving. RPM dropping to zero simultaneously with MAF confirms the engine stopped running at that exact moment rather than a sensor failing independently. All sensors reading normal immediately before the stall eliminates a gradual fault. The simultaneous loss of RPM and MAF — with a normal TPS confirming no throttle event — indicates the engine stopped suddenly from a loss of the PCM's engine position signal, cutting fuel and spark and causing the instant stall.
44. **B. An exhaust manifold leak on bank 1 upstream of the O2 sensor** — Bank 2 LTFT near zero confirms shared system components — MAF, fuel pressure, and EVAP — are operating correctly. Bank 1 LTFT at +22% at idle dropping to +6% at 2,500 RPM is the specific pattern of an exhaust manifold leak upstream of the bank 1 upstream O2 sensor. At idle, exhaust velocity through the manifold is low, allowing atmospheric oxygen from the exhaust manifold leak to diffuse upstream and contaminate the O2 sensor's exhaust sample — the sensor detects elevated oxygen and signals lean, driving the PCM to add fuel aggressively. At 2,500 RPM, higher exhaust velocity purges the leak point more effectively, reducing oxygen contamination of the sensor sample and allowing the trim to partially recover. A smoke test of the intake will not detect an exhaust manifold leak — the test should be directed to the exhaust manifold.
45. **D. Both monitors require a specific manufacturer drive cycle that has not been completed** — No codes are stored and all other monitors are complete — confirming no active fault is preventing execution of either monitor. The catalyst and EVAP monitors are among the most demanding OBD II monitors in terms of specific enable criteria. Both require a defined sequence of operating conditions — specific warm-up temperatures, cruise speeds maintained for defined durations, specific deceleration events, and load conditions — that must occur in a precise order within a single drive event on most vehicles. Mixed city and highway driving over 250 miles does not guarantee this specific sequence has occurred. Performing the manufacturer-specified drive cycle — which defines the exact sequence of operating conditions required to enable and complete both monitors — is the appropriate next step after confirming no fault codes exist.
46. **A. The original CMP sensor's internal Hall effect element failed — it could not switch its output low** — Supply voltage at 5 volts and ground resistance at 0.1 ohms are both confirmed

correct — the sensor's external circuit is intact. A lab scope showing the signal wire at a constant 5 volts during cranking — never switching low — confirms the sensor is receiving correct power but its output transistor never grounds the signal wire regardless of trigger wheel tooth position. A Hall effect sensor works by using an internal transistor to pull the output signal low each time a trigger wheel tooth passes through the magnetic field. A transistor that has failed open cannot pull the output low even when triggered, leaving the signal permanently high at the pull-up reference voltage. Installing a known-good sensor that immediately produces a correct switching signal confirms the external circuit is intact and the original sensor's internal switching element was the fault.

47. **C. A MAF sensor that progressively underreads as airflow increases toward highway cruise levels** — LTFT near +3% at idle and city driving confirms the MAF sensor is reasonably accurate at low airflow conditions — only minor lean correction is needed. The progressive climb to +18% specifically during sustained highway cruise — where airflow through the MAF sensor is highest — confirms the sensor's inaccuracy increases proportionally with airflow rate. A MAF sensor with contamination concentrated on its hot-wire sensing element may read with reasonable accuracy at low-flow idle conditions but underreports progressively as actual airflow increases beyond the sensor's degraded accuracy range. The direct correlation between elevated airflow demand at highway cruise and worsening positive LTFT is the defining pattern of a MAF sensor with a contamination-related accuracy degradation that manifests most severely at high airflow rates.
48. **B. Note the finding and inform the customer** — Mode 6 data showing the upstream O₂ sensor response time at 680 milliseconds against a maximum allowed threshold of 700 milliseconds confirms the monitor is currently passing — no P0133 slow response code has set and the value remains within the allowed range. However, a sensor operating at 97% of its maximum allowed threshold is approaching the boundary of acceptable performance. Mode 6 is specifically designed to surface this type of predictive data — components degrading toward their code-setting threshold before a fault code sets. The appropriate action is to document the finding, inform the customer that the sensor is approaching the end of its performance range, and recommend monitoring at the next service interval or proactive replacement before the response time exceeds the threshold and triggers a P0133 code and MIL illumination.
49. **D. A MAF sensor significantly underreporting actual airflow** — P0300 random misfire combined with P0171 and P0174 bilateral lean codes with LTFT at +23% on both banks is a severe bilateral lean condition affecting the entire engine simultaneously. A smoke test revealing no vacuum leaks and correct fuel pressure at 57 psi eliminates the two most common bilateral lean causes. The MAF reading of 2.1 g/s against a 4.5–6.0 g/s idle specification — less than half the minimum idle specification — confirms the MAF sensor is reporting severely insufficient airflow to the PCM. The PCM uses MAF data to calculate base fuel delivery — a MAF reading at less than half the actual airflow value causes the PCM to deliver less than half the required fuel, creating a severely lean mixture on all cylinders simultaneously, driving +23% LTFT on both banks, causing random misfires from the lean combustion events, and setting bilateral lean codes.

50. **A. A MAF sensor that over-reads above a specific RPM threshold** — LTFT at +3% at idle confirms the base fuel delivery is slightly lean but near normal at idle. The sudden bilateral drop to -15% LTFT specifically at 1,500 RPM — with confirmed inactive EVAP purge eliminating canister vapor as the cause — points to a shared system that begins delivering excess fuel at that specific RPM threshold. A MAF sensor that reads correctly at the low airflow rates of idle but begins significantly over-reading once airflow increases above a specific rate causes the PCM to calculate excessive fuel delivery above the threshold RPM. The PCM responds with negative LTFT to compensate for the excess fuel it is commanding based on the inflated MAF signal. The sharp, RPM-specific onset and bilateral nature of the trim shift — with confirmed inactive purge — identifies the MAF sensor as the most likely source.