

PRACTICE EXAM 17: 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 that slowly drifts between 14 and 19 in/Hg over 3–4 second intervals in a rhythmic, repeating pattern. RPM is stable. What does this MOST likely indicate?

- A. A vacuum leak that opens and closes with intake manifold resonance
- B. A worn timing chain allowing advance and retard cycling at idle
- C. A sticking EGR valve opening and closing intermittently under manifold vacuum
- D. Retarded ignition timing causing periodic combustion inefficiency at idle

2. A compression test on a V8 shows all cylinders between 155 and 170 psi except cylinders 4 and 5, which both read 90 psi dry and 91 psi wet. What does this MOST likely indicate?

- A. A head gasket breach between cylinders 4 and 5
- B. Worn piston rings on both cylinders 4 and 5 simultaneously
- C. Burned exhaust valves on cylinders 4 and 5
- D. Carbon deposits reducing compression on adjacent cylinders

3. An engine has a light tapping from the top end that is present at all temperatures and all RPM. The tapping rate increases directly with RPM. Oil level and pressure are normal. What is the MOST likely cause?

- A. A collapsed hydraulic lifter that cannot recharge under normal oil pressure
- B. A loose accessory drive component contacting the valve cover at RPM
- C. Worn timing chain slap that increases in frequency with RPM
- D. Insufficient valve clearance on a solid-lifter engine requiring adjustment

4. A cylinder leakage test shows 32% on cylinder 2. Air is heard escaping from the radiator overflow tank. The specification is 20% maximum. What does this indicate?

- A. A cracked cylinder 2 piston allowing test air to enter the cooling jacket
- B. A head gasket breach on cylinder 2 allowing test air into the coolant passages
- C. A leaking intake valve routing test air backward through the intake and into the coolant
- D. Worn rings on cylinder 2 with test air escaping through a shared crankcase-to-coolant path

5. An engine produces a rhythmic metallic knock that occurs twice per crankshaft revolution at idle and doubles in rate when RPM is doubled. Oil pressure is normal. What does the twice-per-revolution rate MOST likely indicate?

- A. A worn crankshaft main bearing producing a knock once per revolution on each side
- B. A loose flywheel producing a knock twice per revolution from rotational imbalance
- C. A worn connecting rod bearing — rod bearings load on both the power and compression strokes producing two knock events per crankshaft revolution
- D. Piston slap occurring on both the thrust and anti-thrust sides of the bore per revolution

6. A cooling system pressure test holds correctly for 15 minutes. A combustion leak test using a chemical tester immediately turns the indicator from blue to yellow. What does this confirm?

- A. Combustion gases are present in the coolant — a head gasket or cracked head is allowing combustion products to enter the cooling system

- B. The coolant has a low pH from old antifreeze reacting with the chemical tester
- C. The cooling system has a small internal leak that the pressure test missed
- D. Carbon monoxide from the shop environment is contaminating the tester result

7. A relative compression test shows cylinders 1 through 7 with consistent crank speed and amperage. Cylinder 8 shows significantly slower crank speed and higher amperage than all other cylinders. What does this indicate?

- A. A CKP signal fault near the cylinder 8 firing position inflating the amperage reading
- B. A carbon deposit in cylinder 8 reducing combustion chamber volume slightly
- C. Cylinder 8 has a bent valve causing the piston to contact the valve and create extra resistance
- D. Cylinder 8 has significantly higher compression than all other cylinders

8. An engine has a knock present only at operating temperature that disappears when the engine cools. Oil pressure and level are confirmed normal. What is the MOST likely cause?

- A. Piston slap from bore clearance that is present cold but eliminated by thermal expansion
- B. Worn connecting rod bearings that tighten thermally when cold but produce clearance knock when hot oil thins the oil film
- C. A loose heat shield contacting the exhaust manifold only at operating temperature
- D. Timing chain slack that increases as the chain expands at operating temperature

9. A technician performs a cylinder contribution test. Cylinder 6 drops 185 RPM when disabled — consistent with all other cylinders. However, idle quality immediately improves when cylinder 6 is disabled. What does this indicate?

- A. The cylinder 6 injector is delivering excess fuel causing a rich misfire that the contribution test cannot isolate
- B. The compression on cylinder 6 is borderline — improved idle confirms a partial mechanical fault

C. Cylinder 6 is firing but its combustion event is disturbing idle quality — the misfire source is in the combustion event quality rather than delivery volume

D. The cylinder 6 coil is over-advancing spark causing a timing-related idle disturbance

10. An engine has persistent oil consumption with no external leaks and no visible smoke under any driving condition. Compression and leakage are confirmed normal. What should the technician check NEXT?

A. The PCV system for a fault drawing excessive oil vapor into the intake without producing visible smoke

B. The valve stem seals for internal consumption that produces smoke only under specific unobserved driving conditions

C. The turbocharger oil seal for a minor weep that is burned in the catalytic converter before reaching the tailpipe

D. The crankshaft rear main seal for a leak that is absorbed by the flywheel and not visible externally

11. A snap-throttle vacuum test produces a normal drop and recovery pattern. At the moment of snap-throttle, the vacuum needle drops sharply to zero and immediately overshoots to 24 in/Hg — 6 in/Hg above the baseline — before settling to the normal idle vacuum of 18 in/Hg within 1 second. What does the overshoot above baseline confirm?

A. Good valve spring tension and ring seal — a strong overshoot confirms healthy valve and ring sealing during the rebound compression phase

B. A momentary vacuum leak that seals during the deceleration phase after snap-throttle

C. Retarded ignition timing causing excess vacuum buildup during the deceleration phase

D. Worn valve springs failing to close fully during the deceleration rebound allowing excess vacuum

12. A no-start exists. Fuel pressure is confirmed correct. Compression is confirmed correct. A timing light during cranking shows no flash at any cylinder. The ignition module is confirmed receiving trigger signals from the pickup coil. What should the technician check NEXT?

- A. The ignition coil primary resistance for an open preventing high-voltage production despite receiving the trigger signal
- B. The distributor pickup coil air gap for a setting outside specification preventing adequate trigger signal amplitude
- C. The PCM for a fault disabling spark output despite confirmed trigger signals reaching the module
- D. The crankshaft position sensor for a fault preventing the PCM from enabling spark despite confirmed mechanical trigger signals

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

13. A spark plug shows a melted or blistered porcelain insulator with a melted center electrode tip. The ground electrode shows signs of extreme heat. What does this indicate?

- A. Carbon fouling from prolonged rich operation at high temperature
- B. Normal wear on a plug at the end of an extended service interval
- C. Pre-ignition damage from sustained extreme heat before the spark event
- D. Detonation damage from repeated abnormal pressure spikes during combustion

14. A P0351 ignition coil A primary circuit code is stored. The coil A supply wire shows 12.4 volts. The PCM command wire shows 12.1 volts at rest and drops to 0.2 volts when the PCM commands the coil. Spark is confirmed. What is the MOST likely explanation?

- A. The code was set during a previous intermittent fault — current circuit operation is correct and the code should be cleared and monitored
- B. The 0.2-volt command signal indicates the PCM driver is approaching failure and should be replaced
- C. A high-resistance ground in the coil primary circuit is causing a residual 0.2-volt reading
- D. The 12.1-volt resting voltage confirms a short to power that triggered the stored code

15. A secondary ignition scope shows a normal firing line followed by a normal-length spark line on all cylinders except one, which shows a firing line significantly lower than all other cylinders. The low-firing-line cylinder has no misfire code. What is the MOST likely cause?

- A. A shorted spark plug reducing the voltage required to initiate the arc on that cylinder
- B. A wide spark plug gap requiring extra voltage and consuming the firing line amplitude
- C. A weak coil producing insufficient peak voltage on that firing position
- D. A low-resistance alternate path — a fouled plug or carbon tracking — reducing the required firing voltage on that cylinder

16. A magnetic reluctance CKP sensor waveform shows alternating teeth of two distinct amplitudes — one height for odd-numbered teeth and a lower height for even-numbered teeth throughout the entire revolution. What is the MOST likely cause?

- A. The CKP sensor wiring has an intermittent ground that affects every other tooth signal
- B. The reluctor wheel teeth alternate between two different heights — a manufacturing tolerance variation or physical damage to alternating teeth
- C. The PCM input circuit is filtering alternate teeth to reduce signal noise at high RPM
- D. Normal behavior — alternating amplitudes are a designed feature of some reluctor wheel configurations

17. A COP ignition system has a P0305 misfire on cylinder 5. The cylinder 5 coil is swapped with the cylinder 1 coil. After clearing codes and a test drive, P0301 sets and P0305 does not return. What does this confirm?

- A. The spark plug on cylinder 5 is faulty — the coil swap moved the plug's misfire to cylinder 1
- B. The PCM driver circuit for cylinder 5 has a fault — the misfire did not move with the coil
- C. The coil originally on cylinder 5 has failed — the misfire moved with the coil to cylinder 1
- D. Both the coil and plug on cylinder 5 have failed simultaneously

18. A Hall effect CKP sensor is tested with a lab scope during cranking. The signal switches cleanly between 0 and 5 volts for the first 3 seconds of cranking, then the signal drops permanently to 2.5 volts and the engine fails to start. What is the MOST likely cause?

- A. An intermittent open in the sensor ground circuit — the ground partially fails during cranking, pulling the output to a mid-range voltage
- B. The reluctor wheel has a cracked tooth that breaks off during cranking and jams the sensor
- C. The PCM reference voltage drops during extended cranking causing the signal to settle at half reference
- D. The sensor supply voltage drops below operating threshold during extended cranking causing signal loss

19. A distributor ignition system has a misfire on cylinder 3 at all operating conditions. A new spark plug does not resolve it. Swapping the cylinder 3 plug wire to cylinder 6 does not move the misfire. Compression and leakage on cylinder 3 are normal. What should the technician check NEXT?

- A. The ignition module for a fault affecting only the cylinder 3 firing position in the advance curve
- B. The fuel injector on cylinder 3 for a restriction causing lean misfire
- C. The PCM for an advance calculation fault specific to cylinder 3
- D. The distributor cap terminal for cylinder 3 for carbon tracking, corrosion, or physical damage

20. A technician measures primary coil resistance on a COP coil. The specification is 0.5–1.5 ohms. The meter reads OL (overload/infinite resistance). What does this indicate?

- A. The coil primary winding is shorted — resistance above the maximum specification confirms a shorted condition
- B. The coil primary winding is open — no continuity exists between the primary terminals
- C. The DVOM range is incorrectly set — OL on resistance indicates the range is too low for the measurement
- D. The coil primary winding resistance is above 1.5 ohms — OL indicates a value outside the upper specification limit

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

21. A port injection engine fuel pressure drops from 58 psi to 10 psi within 5 minutes of shutdown. Pinching the return line before shutdown and monitoring pressure shows the same rapid drop. What does pressure dropping with the return line pinched confirm?

- A. The fuel pump check valve is intact and the injectors are the drain-back source
- B. A stuck-open fuel pressure regulator is the drain-back source
- C. The fuel filter is bypassing internally — pressure loss continues despite the pinched return
- D. The fuel pump check valve is faulty — pressure loss continues with the return pinched, confirming the pump as the drain-back source

22. A scan tool shows LTFT at +24% on bank 1 and +22% on bank 2 at idle. At 2,500 RPM, LTFT drops to +4% on both banks. A smoke test reveals no vacuum leaks. Fuel pressure is normal. What should the technician check NEXT?

- A. The fuel injectors for simultaneous restriction on all cylinders causing idle-specific lean delivery
- B. The MAF sensor for contamination causing significant underreading at idle airflow that improves at higher flow rates
- C. The upstream O₂ sensors for simultaneous contamination producing false lean corrections at idle only
- D. The EGR valve for a stuck-open condition diluting the idle mixture on both banks simultaneously

23. A port injection engine has a P0087 fuel pressure low code. Fuel pressure at idle is 42 psi against a 58 psi minimum. With the vacuum line disconnected from the regulator, idle pressure rises to 44 psi. Pinching the return line raises pressure immediately to 61 psi. What does this confirm?

- A. The fuel pressure regulator is stuck open — the pump is capable but cannot build pressure against an open regulator
- B. The fuel pump has insufficient volume — the vacuum reference test confirms pump weakness
- C. The fuel filter is restricted — the return line pinch bypasses the filter and confirms pump output

D. A leaking injector is the cause — the return line pinch isolates the injector leak path

24. A scan tool shows IAT reading 185°F on a vehicle that has been parked overnight in a 70°F ambient environment. No codes are stored related to IAT. What should the technician check FIRST?

- A. The air filter housing for a crack allowing engine bay heat to reach the IAT sensor
- B. The PCM for a stored IAT fault that is not generating a code on this calibration
- C. The IAT sensor and its circuit for a resistance fault causing an elevated false reading
- D. The MAF/IAT sensor wiring for heat damage from proximity to the exhaust system

25. A GDI engine runs correctly at idle. Under moderate acceleration, multiple random misfire codes set and the engine runs rough. High-pressure rail pressure drops from 1,850 psi at idle to 400 psi under acceleration demand. Low-pressure supply is confirmed correct. What is the MOST likely cause?

- A. Multiple leaking high-pressure injectors bleeding rail pressure under acceleration demand
- B. A failing high-pressure pump unable to maintain rail pressure under increased fuel demand
- C. A high-pressure rail pressure sensor reading high at idle and accurately under acceleration
- D. A high-pressure fuel line restriction between the pump and rail causing pressure loss under flow demand

26. A turbocharged engine has correct boost at all RPM under normal driving. During hard acceleration at highway speed, the engine briefly cuts power, boost drops to zero for approximately 2 seconds, then full power resumes. No codes are stored. What should the technician check FIRST?

- A. The boost pressure sensor for an intermittent fault causing the PCM to briefly disable boost control
- B. The wastegate solenoid for an intermittent electrical fault causing momentary wastegate opening
- C. The intercooler for an internal restriction that collapses under sustained high-boost demand
- D. The turbocharger compressor wheel for intermittent contact with the housing under high boost thermal expansion

27. A naturally aspirated engine has a P0171 bank 1 lean and P0174 bank 2 lean stored simultaneously. LTFT is +19% on both banks at all speeds. Fuel pressure is 58 psi. A smoke test reveals no vacuum leaks. MAF reads 5.1 g/s at idle — within specification. What should the technician check NEXT?

- A. The fuel injectors for simultaneous restriction across all cylinders
- B. The upstream O₂ sensors for simultaneous contamination producing false bilateral lean corrections
- C. The fuel pressure regulator for a fault causing pressure drop under dynamic flow conditions not captured by static test
- D. The MAF sensor for a dynamic accuracy fault not detectable by a static idle reading

27. What should the technician check NEXT given a P0171 and P0174 with +19% LTFT on both banks at all speeds, correct fuel pressure, no vacuum leaks, and a static MAF reading within specification at idle?

- A. The fuel injectors for simultaneous restriction
- B. The upstream O₂ sensors for simultaneous contamination
- C. The fuel pressure regulator for dynamic pressure loss
- D. The MAF sensor for a dynamic accuracy fault not detectable by the static idle reading

28. A port injection engine has correct fuel pressure at all operating conditions. All injectors pass a balance test within 3%. MAF reads correctly. LTFT is -16% on bank 1 and +2% on bank 2. A bi-directional test commanding all bank 1 injectors off causes LTFT bank 1 to move toward zero within 15 seconds. What does this confirm?

- A. The bank 1 upstream O₂ sensor is contaminated — injector disable removes the variable and confirms sensor fault
- B. One or more bank 1 injectors are leaking when commanded off
- C. The EVAP purge solenoid is delivering vapor preferentially to bank 1 — injector disable reveals the vapor source
- D. The bank 1 fuel pressure regulator has a fault — injector disable reduces rail pressure and confirms regulator fault

29. An exhaust backpressure test shows 2.1 psi at 2,500 RPM — within the 3.0 psi maximum. A P0420 catalyst efficiency code is stored. The downstream O2 sensor on bank 1 switches at 0.9 cycles per second. The upstream O2 sensor switches at 1.0 cycle per second. What is the correct conclusion?

- A. The backpressure confirms the converter is not restricted — the P0420 is caused by a downstream O2 sensor fault
- B. The slight switching rate difference confirms marginal catalyst efficiency — replacement is indicated
- C. The downstream sensor switching nearly as fast as the upstream confirms lost oxygen storage capacity — the P0420 is valid
- D. The low backpressure confirms the catalyst is physically intact — chemical efficiency cannot be confirmed by backpressure alone and further testing is needed

29. Backpressure is 2.1 psi at 2,500 RPM. P0420 is stored. Downstream O2 switches at 0.9 cycles/sec. Upstream switches at 1.0 cycle/sec. What is the correct conclusion?

- A. Backpressure confirms no restriction — the P0420 is caused by a downstream O2 sensor fault
- B. The slight switching rate difference confirms marginal efficiency — replacement is indicated
- C. Downstream switching nearly as fast as upstream confirms lost oxygen storage — P0420 is valid
- D. Backpressure confirms physical integrity — chemical efficiency requires further testing

30. A vehicle has a consistent 18 psi backpressure reading at 2,500 RPM. Power under load is severely reduced. Idle is normal. The catalytic converter was recently replaced. What should the technician check FIRST?

- A. Whether the replacement converter was installed with the inlet and outlet reversed
- B. The flex pipe for an internal liner collapse that can occur after a converter replacement procedure
- C. The oxygen sensor bung plugs for accidental omission after converter installation
- D. The new converter for a manufacturing defect causing substrate collapse on installation

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

31. A PCV system has a confirmed stuck-open PCV valve. Oil consumption is reported at 1 quart per 1,200 miles. Crankcase pressure with the PCV disconnected is confirmed normal. The fresh air inlet is unobstructed. What is the MOST likely effect of the stuck-open valve?

- A. No significant effect — a stuck-open PCV valve allows full vacuum to the crankcase but does not directly cause measurable oil consumption
- B. Minimal effect on oil consumption — a stuck-open valve primarily causes rough idle from unmetered air
- C. The stuck-open valve allows excessive manifold vacuum to draw oil vapor and droplets through the system at a rate consistent with the reported consumption
- D. The stuck-open valve causes backpressure in the crankcase that forces oil past seals rather than drawing it into the intake

32. A vehicle has a P0300 random misfire and elevated tailpipe HC. LTFT is +1% on both banks. A cylinder contribution test shows cylinder 4 dropping 30 RPM compared to 180–200 RPM on all others. Compression and leakage on cylinder 4 are normal. What should the technician check NEXT on cylinder 4?

- A. The ignition components — coil, plug, and wire — for a fault causing the specific cylinder 4 misfire
- B. The fuel injector for restriction causing lean delivery on cylinder 4
- C. A vacuum leak at the cylinder 4 intake port causing isolated lean misfire
- D. The PCM driver circuit for cylinder 4 for a fault reducing coil energy

33. A P0446 EVAP vent circuit fault is stored. A bi-directional test commands the vent solenoid open. Tank pressure drops from +0.4 in/Hg to 0.0 in/Hg immediately. A bi-directional test commands the vent solenoid closed. Tank pressure during a subsequent EVAP monitor run rises to +0.8 in/Hg and holds — confirming the solenoid seals when commanded. What should the technician check NEXT?

- A. The purge solenoid for a stuck-open condition interfering with the vent monitor evaluation

- B. The charcoal canister for saturation causing abnormal pressure buildup during the monitor run
- C. The fuel tank pressure sensor for an offset or drift causing incorrect readings during the monitor evaluation
- D. The vent tube from the canister to the atmosphere for a restriction or blockage preventing flow when the vent opens

33. P0446 EVAP vent circuit fault. Vent solenoid opens and closes correctly on bi-directional test. Tank pressure rises and holds correctly when solenoid is closed. What should the technician check NEXT?

- A. The purge solenoid for a stuck-open condition interfering with the vent monitor
- B. The charcoal canister for saturation
- C. The fuel tank pressure sensor for offset or drift
- D. The vent tube for a restriction or blockage preventing flow when the vent opens

34. A vehicle has elevated NO_x on a tailpipe test. EGR is confirmed operating and flowing. Ignition timing is confirmed correct. LTFT is +14% on both banks at idle. What is the MOST likely cause of the elevated NO_x?

- A. Carbon deposits in the combustion chambers raising the effective compression ratio
- B. A lean air-fuel mixture raising combustion temperature and increasing NO_x formation
- C. A degraded catalytic converter with reduced rhodium NO_x reduction efficiency
- D. Insufficient EGR flow despite confirmed valve operation — flow volume may be below the NO_x reduction threshold

35. A vehicle has a P0141 downstream O₂ sensor heater fault on bank 1. The heater supply voltage is 12.4 volts. The PCM heater control circuit ground resistance is 0.08 ohms. The heater element measures OL (open) on a DVOM. What is the correct repair?

- A. Repair the PCM heater control ground circuit — 0.08 ohms exceeds the maximum specification
- B. Replace the bank 2 downstream O₂ sensor — the supply voltage is above normal range

- C. Replace the bank 1 downstream O2 sensor — the open heater element confirms internal sensor failure
- D. Inspect the heater supply fuse — an OL heater reading may indicate a supply circuit fault rather than a sensor fault

36. An AIR system test during cold start shows the pump operating. Both upstream O2 sensors show no lean response for the full 30-second pump run on either bank. The check valves on both banks are confirmed open. What should the technician check NEXT?

- A. Both upstream O2 sensor heaters for a fault causing premature sensor activation on both banks simultaneously
- B. The AIR pump output pressure for a fault — confirmed rotation does not confirm adequate airflow output
- C. The PCM AIR monitor calibration for a lean signal threshold that this pump cannot achieve
- D. The AIR distribution tubes on both banks for simultaneous blockage despite confirmed check valve operation

36. AIR pump is running. Check valves on both banks are open. Neither upstream O2 sensor shows a lean response. What should the technician check NEXT?

- A. Both upstream O2 sensor heaters for simultaneous premature activation
- B. The AIR pump output for a fault — rotation does not confirm adequate airflow
- C. The PCM AIR monitor calibration threshold
- D. Both AIR distribution tubes for simultaneous blockage

37. A vehicle has a P0411 AIR system incorrect flow code. The pump runs and check valves are open. The upstream O2 sensors show a lean response but the response magnitude is below the PCM's threshold. A pressure test at the AIR manifold shows low output pressure. What is the MOST likely cause?

- A. A worn AIR pump generating insufficient air volume and pressure despite confirmed mechanical operation

- B. A partially blocked AIR distribution tube reducing delivery volume at the exhaust ports
- C. Both check valves are partially restricted — flow passes but insufficient volume reaches the exhaust
- D. An intake manifold vacuum leak reducing the lean signal magnitude below the monitor threshold

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

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

- A. A minor rich condition is present — negative trims on both banks at all speeds indicate a developing fuel fault
- B. The MAF sensor is reading slightly high at idle — idle-biased negative trims confirm MAF contamination
- C. A stuck-open EVAP purge solenoid is the likely cause — bilateral negative trims at all speeds indicate unmetered vapor
- D. Fuel trims are within the normal operating range — no fault is indicated

39. A vehicle has P0171 bank 1 lean and LTFT at +22% on bank 1. LTFT bank 2 is +2%. All bank 1 injectors pass a balance test. Fuel pressure is correct. A smoke test of the bank 1 intake reveals no vacuum leaks. What should the technician check NEXT?

- A. The MAF sensor for contamination selectively affecting bank 1 airflow calculation
- B. An exhaust manifold leak on bank 1 upstream of the O₂ sensor introducing atmospheric oxygen
- C. The bank 1 upstream O₂ sensor for contamination producing false lean corrections
- D. The EVAP purge solenoid for preferential vapor delivery to bank 1

40. A scan tool during a cold start shows STFT at +22% for the first 60 seconds, then STFT drops to +3% as the engine enters closed loop. LTFT on both banks is +2% after the drive. What does the elevated cold-start STFT indicate?

- A. A vacuum leak that seals with thermal expansion during warm-up
- B. A lean air-fuel mixture during cold start from an incorrect cold-start enrichment map
- C. Normal cold-start open-loop operation where the PCM applies fixed enrichment and STFT reflects the base map correction
- D. An ECT sensor reading warmer than actual causing insufficient cold-start enrichment

40. Cold start STFT is +22% for the first 60 seconds then drops to +3% at closed-loop entry. LTFT is +2% after the drive. What does the elevated cold-start STFT indicate?

- A. A vacuum leak sealing with thermal expansion
- B. A lean condition from incorrect cold-start enrichment
- C. Normal closed-loop correction from a base map that runs lean during open-loop warm-up
- D. An ECT sensor reading warmer than actual causing insufficient enrichment

41. A vehicle has STFT at +2% and LTFT at +3% on both banks at idle and cruise. After a period of highway driving, LTFT drops to -5% on both banks for 3 minutes and returns to +3%. The EVAP monitor confirms active during the trim drop. What does this confirm?

- A. A MAF sensor that begins over-reading at highway cruise airflow
- B. Normal EVAP canister purge operation adding fuel vapor at cruise conditions
- C. A fuel pressure spike at highway speed causing momentary over-delivery
- D. A vacuum leak that seals at highway speed reducing the lean condition temporarily

42. A vehicle has a P0507 idle control high RPM code. Idle speed is 1,450 RPM. The IAC valve tests functionally correct. The throttle plate closes fully confirmed by visual inspection. What should the technician check NEXT?

- A. The PCM for an idle speed calibration fault commanding elevated RPM through a correct IAC
- B. The throttle body bore for a carbon deposit bypassing the closed throttle plate

- C. The TPS for a fault causing the PCM to misread throttle position and command elevated idle air
- D. A vacuum leak providing uncontrolled bypass air that the IAC cannot compensate for

43. A vehicle has a P0336 CKP sensor range/performance code. The sensor signal is present on a scope during cranking. The signal is clean for most of the revolution but shows one tooth signal with significantly lower amplitude than all others — at the same position every revolution. What is the MOST likely cause?

- A. An intermittent open in the CKP sensor signal wire affecting only one firing position
- B. The PCM input circuit has a noise filter that attenuates one tooth per revolution
- C. A damaged or worn reluctor wheel tooth at that position producing a weaker magnetic field change
- D. Debris temporarily lodging at the sensor face and reducing signal amplitude at that position

44. A vehicle has LTFT at +19% on bank 1 and +2% on bank 2. A smoke test of the bank 1 intake reveals a seeping throttle body base gasket on bank 1. What is the correct repair and verification?

- A. Replace the bank 1 throttle body base gasket, clear codes, and verify LTFT bank 1 normalizes after a drive cycle
- B. Replace both the bank 1 throttle body gasket and the upstream O2 sensor as a precaution
- C. Apply sealant to the bank 1 throttle body base and retest LTFT before committing to gasket replacement
- D. Replace the throttle body assembly — a seeping base gasket confirms the throttle body housing is warped

45. A vehicle has all OBD II monitors complete except the EVAP monitor after 500 miles of post-reset driving. No codes are stored. The fuel cap is confirmed sealing correctly. What is the MOST likely reason the EVAP monitor has not completed?

- A. A very small EVAP leak below the P0442 threshold is preventing the monitor from achieving a pass result
- B. The O2 sensor monitor must complete before the EVAP monitor can run — it should be verified as complete first

C. The EVAP monitor requires a cold soak period before a drive — the vehicle may not have been cold-soaked at the start of a drive event

D. The fuel tank has been filled above 85% capacity — most EVAP monitors require the fuel level to be between 15% and 85% to run

46. A vehicle has a P0300 random misfire that sets only during cold ambient temperatures. LTFT is +3% when warm and +19% when cold. No vacuum leak is found by smoke test when cold. What is the MOST likely cause?

A. An ignition coil with degraded insulation that arcs internally at cold temperatures

B. A cold-sensitive intake manifold gasket or rubber component that shrinks below a specific temperature creating a vacuum leak

C. A MAF sensor that reads low at cold intake air temperatures causing lean delivery during cold operation

D. An IAC valve that sticks in cold conditions causing insufficient idle airflow and rich misfire

47. A vehicle has a P0102 MAF sensor low input code. MAF signal voltage at idle is 0.3 volts against a 0.9–1.1 volt specification. LTFT is +31% on both banks. The air filter is new. Supply voltage to the MAF sensor is 12.3 volts. Ground resistance is 0.1 ohms. What should the technician check NEXT?

A. The MAF sensor signal wire for high resistance between the sensor and PCM input

B. The MAF sensor hot-wire element for contamination causing reduced output voltage

C. The MAF sensor for an internal failure — with correct supply, ground, and clean filter, the sensor is the most likely fault

D. The PCM MAF input circuit for a fault reducing the received signal voltage

48. A vehicle has all OBD II monitors complete. A pending P0420 code is stored but the MIL is not illuminated. Mode 6 data shows the catalyst monitor test value at 97% of the maximum allowed threshold. What is the correct interpretation?

A. The catalyst has nearly failed — the pending code and Mode 6 value together confirm imminent converter failure requiring replacement

B. The pending code will clear on its own — a single incomplete monitor trip is normal and does not require action

C. The pending code confirms the catalyst monitor failed on its most recent evaluation — a second consecutive failure will set the MIL

D. Mode 6 at 97% with a pending code confirms the sensor is slow rather than the converter failed — the upstream O2 sensor should be evaluated first

49. A vehicle has a P0172 rich code on bank 1. LTFT bank 1 is -21%. LTFT bank 2 is +2%. Injector balance on bank 1 shows all injectors within 3%. MAF is confirmed correct. Fuel pressure is correct. A scope of the bank 1 upstream O2 sensor shows normal switching between 0.1 and 0.9 volts at the correct rate. What should the technician check NEXT?

A. A head gasket breach on bank 1 allowing combustion gases to contaminate the exhaust upstream of the O2 sensor

B. The EVAP purge solenoid for a stuck-open condition delivering vapor preferentially to bank 1

C. A bank 1 exhaust manifold leak downstream of the O2 sensor affecting catalyst efficiency

D. An intermittent leaking bank 1 injector that passes the balance test but seeps between test intervals

49. P0172 bank 1 rich. LTFT bank 1 is -21%. Bank 2 LTFT is +2%. Injectors, MAF, and fuel pressure are all confirmed normal. Bank 1 upstream O2 sensor switches normally. What should the technician check NEXT?

A. A bank 1 head gasket breach allowing combustion gas contamination of the exhaust stream

B. A stuck-open EVAP purge solenoid delivering vapor preferentially to bank 1

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

D. An intermittent leaking bank 1 injector that passes the balance test but seeps between tests

50. A vehicle has STFT at +3% and LTFT at +4% on both banks. A scan tool commanded EVAP purge test causes LTFT to drop to -6% on both banks within 2 minutes then recover to +4% when purge is commanded off. No P0172 or P0175 codes are stored. What does this confirm?

- A. The EVAP purge system is functioning and delivering fuel vapor when commanded — the LTFT response confirms normal purge flow
- B. A stuck-open EVAP purge solenoid is confirmed — the LTFT drop only occurs because the solenoid was already open before the command
- C. The EVAP canister is saturated — the large LTFT response confirms excessive vapor delivery from a full canister
- D. The fuel pressure regulator is affected by purge vacuum — the LTFT drop confirms a regulator fault during purge operation

PRACTICE EXAM 17: ANSWER KEY AND EXPLANATIONS

DOMAIN A — GENERAL DIAGNOSIS

1. **C. A sticking EGR valve opening and closing intermittently under manifold vacuum** — A vacuum needle that drifts rhythmically between 14 and 19 in/Hg over 3–4 second intervals in a consistent repeating pattern is the characteristic presentation of an EGR valve that is responding to manifold vacuum by intermittently opening and closing. When the EGR valve opens, inert exhaust gas dilutes the intake charge and reduces manifold vacuum. When it closes, normal combustion efficiency resumes and vacuum rises. The regular, rhythmic cycling — not the random, erratic flutter of a sticking mechanical valve — is caused by the EGR valve's vacuum-operated diaphragm responding to the normal idle vacuum fluctuation in a feedback loop. A worn timing chain produces hunting RPM rather than rhythmic vacuum swings, and a vacuum leak produces a steady depressed reading rather than cyclic drift.
2. **A. A head gasket breach between cylinders 4 and 5** — Two adjacent cylinders — 4 and 5 — both reading 90 psi dry with only 1 psi wet test improvement on each is the defining compression pattern of a head gasket breach between those two cylinders. When a head gasket fails between two adjacent cylinders, compression leaks from each cylinder into the other, equalizing pressure in both combustion chambers to a value midway between their normal readings. Oil introduced during the wet test cannot seal a gasket breach — the head gasket failure is between cylinder bores, not at the ring seal — explaining the minimal wet test response on both cylinders simultaneously. A bilateral ring failure would show wet test improvement on both cylinders, and burned valves would affect only one cylinder at a time without the cross-cylinder equalization pattern.
3. **D. Insufficient valve clearance on a solid-lifter engine requiring adjustment** — A light, consistent tapping from the top end that is present at all temperatures and all RPM, increasing in rate directly with RPM, is the presentation of mechanical valve train noise from incorrect valve clearance on a solid-lifter valvetrain. Solid-lifter engines require periodic manual adjustment of valve clearance — a clearance set too tight causes the valve to contact the rocker or cam lobe with insufficient clearance for thermal expansion, producing a consistent ticking that tracks directly with engine speed. The presence at all temperatures distinguishes this from a hydraulic lifter bleed-down, which clears after warm-up. Normal oil pressure and level rule out lubrication-related valvetrain noise.
4. **B. A head gasket breach on cylinder 2 allowing test air into the coolant passages** — Air escaping from the radiator overflow tank during a cylinder leakage test on cylinder 2 confirms the

test air is entering the cooling system and pressurizing it to the point of displacing coolant through the overflow. The only path from the combustion chamber to the cooling system is through a compromised head gasket or cracked cylinder head — the coolant passages run adjacent to the combustion chambers, and a gasket breach between the combustion chamber and a coolant passage allows pressurized test air to flow directly into the cooling system. Worn rings route air to the crankcase, an intake valve leak routes air to the intake manifold, and a cracked piston is extremely rare and would typically produce other symptoms.

5. **C. A worn connecting rod bearing producing two knock events per crankshaft revolution** — A knock that occurs twice per crankshaft revolution and doubles in rate with RPM confirms the knock source completes two cycles for every single crankshaft rotation. Connecting rod bearings load twice per crankshaft revolution — once during the power stroke when combustion pressure forces the piston down and loads the big-end bearing, and once during the compression stroke when the piston decelerates and reverses direction. Each load reversal produces a knock event at a worn bearing interface, generating two knock events per revolution. A main bearing knock typically occurs once per revolution. Piston slap occurs once per revolution on the thrust side. The consistent twice-per-revolution rate confirmed across RPM ranges is the clinical signature of rod bearing wear.
6. **A. Combustion gases are present in the coolant** — A combustion leak test using a chemical block tester draws air from above the coolant surface in the radiator or overflow tank through a chemical indicator solution. The indicator changes from blue to yellow in the presence of hydrocarbons — specifically the combustion byproducts of burned fuel, including unburned hydrocarbons and CO₂. An immediate color change from blue to yellow confirms combustion gases are entering the cooling system through a breached head gasket or cracked cylinder head. The cooling system pressure test holding correctly confirms no coolant is escaping externally, but the combustion leak test detects the one-way path where combustion pressure forces gases into the coolant without causing measurable pressure loss during static testing.
7. **D. Cylinder 8 has significantly higher compression than all other cylinders** — A relative compression test measures the resistance the starter encounters as it cranks each cylinder through its compression stroke. Higher compression requires more current and more effort to compress — producing slower crank speed and higher amperage at that position. Cylinder 8 showing significantly slower crank speed and higher amperage than all other cylinders confirms it is generating more compression resistance than any other cylinder. This is most commonly caused by excessive carbon buildup in the combustion chamber reducing clearance volume and raising the effective compression ratio, or less commonly by a machining error or incorrect head gasket thickness. The finding warrants further investigation before condemning any component.
8. **B. Worn connecting rod bearings that produce clearance knock at operating temperature** — A knock present only at operating temperature that disappears when cool is the temperature-dependent presentation of worn connecting rod bearings. Engine oil viscosity decreases

significantly at operating temperature — hot, thinned oil forms a thinner hydrodynamic film between the bearing journal and the bearing shell than cold oil does. When bearings are worn to the point of excessive clearance, cold oil's higher viscosity partially fills the excess clearance and dampens the knock. As oil temperature rises and viscosity drops, the oil film thins and can no longer bridge the worn clearance, allowing metal-to-metal impact under combustion loading and producing the temperature-dependent knock. Normal oil pressure confirms oil is reaching the bearings but cannot overcome the mechanical clearance fault.

9. **C. Cylinder 6 is firing but its combustion event is disturbing idle quality** — The cylinder contribution test shows cylinder 6 dropping 185 RPM when disabled — consistent with all other cylinders — confirming it is delivering approximately normal power contribution. However, idle quality immediately improves when cylinder 6 is disabled, confirming cylinder 6's combustion event is negatively affecting idle smoothness despite contributing normal power. This contradictory result — normal contribution but improved idle when disabled — indicates the cylinder is firing but producing an abnormal combustion event that disturbs crankshaft rotation in a way that smooths out when the cylinder is removed from the firing order. A timing fault, incorrect injector spray pattern, or combustion quality issue specific to that cylinder can cause this presentation without reducing total power contribution below the contribution test threshold.
10. **A. The PCV system for a fault drawing excessive oil vapor into the intake** — Confirmed normal compression and leakage eliminate ring seal as the consumption path. No external leaks and no visible smoke under any driving condition rule out the most commonly observed consumption paths. A PCV system fault — specifically a stuck-open PCV valve, a blocked oil separator, or a collapsed PCV hose creating high crankcase vacuum — can draw excessive oil vapor and oil droplets from the crankcase into the intake manifold at a rate that produces measurable consumption without generating visible blue smoke. The catalytic converter oxidizes the oil vapor before it reaches the tailpipe, eliminating visible exhaust evidence. Confirming PCV system integrity — valve function, separator condition, and crankcase pressure — is the appropriate next step when consumption occurs with no other identified path.
11. **A. Good valve spring tension and ring seal** — The snap-throttle test evaluates several engine systems simultaneously. The sharp drop to zero at snap-throttle is normal — sudden throttle opening briefly equalizes manifold pressure with atmosphere. The momentary overshoot above baseline to 24 in/Hg — 6 in/Hg above the idle reading — is produced by the pistons rapidly pumping against the partially closed throttle immediately after snap-throttle closure during deceleration. A strong overshoot requires both good ring seal — to generate high compression pumping efficiency — and adequate valve spring tension to close the intake valves firmly and rapidly during the deceleration compression events. A weak overshoot or failure to overshoot above the baseline confirms either poor ring seal or weak valve springs that cannot generate the rebound vacuum spike.

12. **D. The crankshaft position sensor for a fault preventing the PCM from enabling spark** — Fuel pressure and compression are confirmed correct, eliminating fuel and mechanical causes. A timing light showing no flash at any cylinder during cranking confirms no spark is being delivered to any plug wire. The ignition module is confirmed receiving trigger signals from the pickup coil — confirming the module has the trigger input it needs. Despite receiving the trigger signals, no spark output is produced, confirming the module has the required input but cannot produce output. On systems where the PCM controls spark enable based on CKP signal confirmation, a failed CKP sensor prevents the PCM from authorizing spark output — the module has a trigger signal but the PCM's enable command, which requires CKP confirmation of crankshaft position, is not being generated because the CKP is not providing its required input.

DOMAIN B — IGNITION SYSTEM DIAGNOSIS AND REPAIR

13. **C. Pre-ignition damage from sustained extreme heat** — A melted or blistered porcelain insulator with a melted center electrode tip and signs of extreme heat on the ground electrode is the definitive appearance of a pre-ignition damaged spark plug. Pre-ignition occurs when a hot spot in the combustion chamber — a glowing carbon deposit, a sharp valve edge, or a damaged piston — ignites the air-fuel mixture before the spark event. The sustained extreme heat generated by uncontrolled pre-ignition combustion — which occurs earlier in the compression stroke than normal combustion — exposes the spark plug to temperatures far above its design limits, melting the porcelain insulator and the electrode tips. Detonation damage produces chipped or mechanically eroded electrodes rather than melted components, and carbon fouling produces black deposits without melting.
14. **A. The code was set during a previous intermittent fault — current operation is correct** — Supply voltage of 12.4 volts is confirmed at the coil, the command wire rests at 12.1 volts — near battery voltage as expected when the PCM driver transistor is open — and drops to 0.2 volts when the PCM commands the coil, which is near zero and confirms the driver is fully saturating and grounding the circuit. Spark is confirmed produced. All circuit elements are functioning correctly in their current state. The stored P0351 code was set during a previous event when the circuit was actually faulted — a momentary open, a connector disturbance, or a thermal intermittent that has since resolved. The appropriate action is to clear the code, confirm current normal operation, and monitor for recurrence before pursuing further diagnosis.
15. **D. A low-resistance alternate path reducing required firing voltage** — On a secondary ignition scope, the firing line height represents the voltage required to initiate the spark arc across the plug gap. A firing line significantly lower than all other cylinders — without a misfire code — confirms the arc on that cylinder is initiating at a lower-than-normal voltage. Lower-than-normal required firing voltage indicates the secondary circuit on that cylinder has an easier path to ground than the designed spark gap — a fouled plug with carbon bridging, a cracked plug insulator, or carbon tracking on the distributor cap terminal or coil tower provides a low-resistance alternate conduction

path. The arc initiates through this easier path at lower voltage, producing the reduced firing line height. No misfire code confirms the cylinder is still firing — just through an abnormal path.

16. **B. The reluctor wheel teeth alternate between two different heights** — A magnetic reluctance sensor generates voltage proportional to the rate of magnetic field change as each tooth passes. Teeth of two alternating heights produce two consistent but different amplitude signals that repeat in a predictable odd-even pattern throughout every revolution. This alternating amplitude pattern — consistent and repeating on every revolution in the same positions — confirms a physical characteristic of the reluctor wheel itself rather than an electrical fault. A wiring fault would produce random, non-repeating amplitude variations. Alternating tooth height can result from a manufacturing tolerance deviation or from physical damage — wear or impact — that has selectively affected alternating teeth. The consistent, predictable pattern distinguishes a wheel fault from an electrical or sensor fault.
17. **C. The coil originally on cylinder 5 has failed** — The cylinder 5 coil is moved to the cylinder 1 position. After clearing codes and a test drive, P0301 sets on cylinder 1 — the new position of the suspect coil — and P0305 does not return on cylinder 5, which is now served by a known-good coil. The misfire traveled with the coil to its new location and the original cylinder 5 position stopped misfiring when served by a functional coil. This is the definitive coil swap test result confirming the coil as the fault source. The PCM driver circuit for cylinder 5 is confirmed not at fault — if the driver were the cause, the misfire would have remained at the cylinder 5 position regardless of which coil was installed there.
18. **A. An intermittent open in the sensor ground circuit** — The signal switches cleanly for the first 3 seconds of cranking — confirming the sensor, supply voltage, and signal circuit are initially correct. After 3 seconds of cranking, the signal drops to a fixed 2.5 volts — exactly half of the 5-volt reference. A Hall effect sensor's output is pulled to ground through its internal switching transistor when triggered and rises to the reference voltage through a PCM pull-up resistor when not triggered. If the sensor's ground connection develops an intermittent open during cranking — from vibration, a marginal connector, or a heat-sensitive connection — the output can no longer be pulled fully to ground. The result is a voltage that settles at the midpoint between the pull-up reference and the partially floating ground path, producing the 2.5-volt fixed reading observed after ground circuit failure.
19. **D. The distributor cap terminal for cylinder 3 for carbon tracking, corrosion, or physical damage** — The new spark plug does not resolve the misfire, eliminating the plug. Swapping the cylinder 3 plug wire to cylinder 6 does not move the misfire — the fault stays on cylinder 3 regardless of which wire is connected to it, eliminating the wire. Normal compression and leakage eliminate mechanical causes. With the plug and wire — the two swappable ignition components — both confirmed not at fault, and mechanical causes eliminated, the fixed secondary circuit component specific to cylinder 3 that cannot be swapped without disassembly is the distributor

cap terminal. Corrosion, a burned tip, or carbon tracking on the cap terminal for cylinder 3 prevents adequate voltage delivery to that cylinder regardless of which wire or plug is installed.

20. **B. The coil primary winding is open** — A DVOM reading of OL — overload or infinite resistance — on a primary winding resistance test indicates no continuity exists between the primary terminals. The winding has an internal open circuit — a broken wire within the winding, a disconnected terminal, or a failed solder joint — that prevents any current from flowing through the primary circuit. An open primary winding produces no magnetic field during dwell and therefore no secondary high voltage — the coil will not fire. A shorted winding would read near zero ohms, not OL. An OL reading is not a meter range issue on a resistance test when the component should have measurable resistance in the low-ohm range — it confirms a complete absence of continuity.

DOMAIN C — FUEL, AIR INDUCTION, AND EXHAUST SYSTEMS

21. **D. The fuel pump check valve is faulty — pressure loss continues with the return pinched** — Rapid pressure drop from 58 psi to 10 psi within 5 minutes of shutdown identifies a significant post-shutdown drain-back path. Pinching the return line before shutdown eliminates the return circuit as a drain-back path — no fuel can flow backward through the regulator or return line with the line physically blocked. Pressure continuing to drop at the same rate with the return line pinched confirms the drain-back is occurring through the fuel pump's internal check valve, not through the return circuit. The pump check valve is designed to maintain residual system pressure after shutdown by preventing fuel from flowing backward through the pump into the tank — a failed check valve allows unrestricted reverse flow regardless of whether the return line is open or pinched.
22. **B. The MAF sensor for contamination causing significant underreading at idle** — LTFT at +24% and +22% on both banks at idle — dropping to +4% at 2,500 RPM — is the bilateral idle-specific lean pattern of a MAF sensor with contamination that preferentially affects accuracy at low airflow rates. At idle, the contaminated hot-wire element underreports actual airflow significantly, causing the PCM to under-deliver fuel and requiring large positive LTFT corrections. As RPM and airflow increase, the higher flow velocity over the hot-wire element partially self-compensates for the contamination effect, improving sensor accuracy and reducing the required LTFT correction. A smoke test confirming no vacuum leaks eliminates unmetered air as the bilateral lean cause, directing the diagnosis to the shared metering component — the MAF sensor.
23. **A. The fuel pressure regulator is stuck open** — Fuel pressure at idle is 42 psi with the vacuum line connected — 16 psi below the 58 psi minimum. With the vacuum line disconnected, pressure rises slightly to 44 psi — confirming the regulator is responding to vacuum reference but its base spring pressure setting is also well below specification. Pinching the return line causes pressure to immediately rise to 61 psi — confirming the pump is capable of generating and delivering well above specification pressure when the return circuit is blocked. The pump's ability to reach 61 psi with the return pinched confirms it has adequate output. The failure to build pressure with the

return open — but immediate recovery when return flow is blocked — confirms the regulator is allowing essentially unrestricted fuel return at all times, preventing rail pressure from building regardless of pump output.

24. **C. The IAT sensor and its circuit for a resistance fault causing an elevated false reading** — An IAT reading of 185°F on a vehicle that has been parked overnight in a 70°F ambient environment is physically impossible if the sensor is measuring actual intake air temperature — intake air temperature after an overnight soak at ambient temperature should read very close to the ambient temperature. No codes related to IAT stored confirms the PCM has not detected the reading as outside a plausible range on this calibration. The most common cause of a falsely elevated IAT reading is a thermistor that has drifted toward a lower resistance value — IAT sensors are negative temperature coefficient thermistors, and lower resistance corresponds to higher indicated temperature — producing a reading far above ambient without setting a code if the value remains within the sensor's physical operating range.
25. **B. A failing high-pressure pump unable to maintain rail pressure under increased fuel demand** — Low-pressure supply is confirmed correct at the high-pressure pump inlet, confirming the pump has adequate fuel supply. At idle with low fuel demand, the high-pressure pump maintains 1,850 psi — within specification — confirming it can generate correct pressure when demand is low. Under moderate acceleration, fuel demand increases as injector pulse widths widen to deliver more fuel volume. A high-pressure pump with worn internal components — degraded plunger seals, worn cam follower, or weakened inlet check valve — can maintain specification pressure at low idle demand but cannot sustain the higher flow volume required under acceleration, causing rail pressure to collapse to 400 psi as demand exceeds the pump's delivery capacity.
26. **A. The boost pressure sensor for an intermittent fault causing the PCM to briefly disable boost** — Correct boost under all normal driving conditions confirms the turbocharger, wastegate, and boost control hardware are functioning correctly. A brief, intermittent 2-second power and boost loss during hard acceleration at highway speed that self-recovers without setting codes points to a momentary control system fault rather than a mechanical failure. A boost pressure sensor that intermittently outputs a spike above the PCM's overboost protection threshold — even briefly — causes the PCM to momentarily disable boost control as a protective response, cutting power and venting boost for the duration of the false overboost signal. When the sensor returns to its normal output, the PCM restores boost control and power recovers. The absence of codes is consistent with a very brief event that does not meet the code-setting duration threshold.
27. **D. The MAF sensor for a dynamic accuracy fault not detectable by a static idle reading** — P0171 and P0174 simultaneously with +19% LTFT on both banks at all speeds confirms a severe bilateral lean condition affecting the entire engine. Correct fuel pressure and no vacuum leaks from smoke testing eliminate the two primary bilateral lean causes. The static MAF reading of 5.1 g/s at idle falling within specification appears to clear the sensor — but a static specification check at idle does not confirm dynamic accuracy across the full operating range. A MAF sensor with hot-

wire contamination may produce an acceptable idle reading while significantly underreporting airflow at higher flow rates — the +19% LTFT at all speeds, including cruise, suggests the underreading extends beyond idle into higher airflow conditions that the static idle check did not capture.

28. **B. One or more bank 1 injectors are leaking when commanded off** — All bank 1 injectors pass the balance test within 3%, confirming their commanded delivery volume and electrical operation are correct. Fuel pressure is correct and bank 2 LTFT is near zero, confirming no shared system fault. Despite confirmed correct commanded delivery, LTFT bank 1 is at -16% — the PCM is removing 16% of commanded fuel to maintain stoichiometry, confirming excess fuel is entering the bank 1 cylinders beyond what is being commanded. Commanding all bank 1 injectors electrically off and observing LTFT recover toward zero within 15 seconds confirms the injectors are the source of the excess fuel. At least one bank 1 injector continues delivering fuel through a leaking needle or seat even when electrically commanded closed, a fault that a balance test cannot detect.
29. **C. Downstream switching nearly as fast as upstream confirms lost oxygen storage — P0420 is valid** — Backpressure of 2.1 psi at 2,500 RPM — within the 3.0 psi maximum — confirms the converter substrate is not physically collapsed or restricted. However, the downstream O₂ sensor switching at 0.9 cycles per second against the upstream rate of 1.0 cycle per second — a difference of only 0.1 cycles per second — confirms the converter has lost virtually all of its oxygen storage capacity. A functioning converter buffers the downstream exhaust composition by storing and releasing oxygen, causing the downstream sensor to switch at a rate several times slower than the upstream. A downstream rate nearly identical to the upstream rate confirms no buffering is occurring — the exhaust passes through the converter substrate essentially unchanged in oxygen content. The P0420 is valid and converter replacement is indicated.
30. **A. Whether the replacement converter was installed with the inlet and outlet reversed** — A confirmed intact external converter appearance with 18 psi backpressure — six times the maximum specification — on a recently replaced converter directs suspicion immediately to the installation procedure. Catalytic converters have a defined inlet and outlet — the inlet cone is sized to accept exhaust flow and the substrate is oriented directionally. Installing the converter with inlet and outlet reversed forces exhaust to enter through the outlet cone and push against the substrate's designed flow direction, creating severe restriction and catastrophic backpressure immediately after installation. This is the first and most critical verification after any recent converter replacement when abnormal backpressure is found — it is a simple check that eliminates the most common post-replacement error before pursuing other causes.

DOMAIN D — EMISSIONS CONTROL SYSTEMS

31. **C. The stuck-open valve allows excessive manifold vacuum to draw oil vapor and droplets through the system** — A PCV valve that is stuck fully open allows unregulated manifold vacuum — which at idle can reach 18 in/Hg or more — to act directly on the crankcase without the flow-

limiting restriction the PCV valve is designed to provide. This unregulated vacuum draws crankcase gases, oil vapor, and fine oil droplets through the PCV system and into the intake manifold at a much higher rate than a correctly functioning valve would allow. The reported consumption of 1 quart per 1,200 miles is consistent with this elevated oil vapor and droplet draw rate. Confirmed normal crankcase pressure with the PCV disconnected confirms the crankcase itself is not overpressurized — the consumption path is through the stuck-open valve's unrestricted vacuum draw rather than crankcase pressure forcing oil out.

32. **A. The ignition components — coil, plug, and wire — on cylinder 4** — The cylinder contribution test shows cylinder 4 dropping only 30 RPM compared to 180–200 RPM on all other cylinders, confirming cylinder 4 is contributing very little power and misfiring on most firing events. Neutral LTFT of +1% on both banks eliminates a mixture fault as the primary cause. Confirmed normal compression and leakage on cylinder 4 eliminate mechanical causes. With mixture and mechanical causes eliminated and a specific cylinder identified as near-completely misfiring, the systematic ignition diagnosis approach is to check the components specific to cylinder 4's ignition circuit — the coil, spark plug, and plug wire in sequence. These are the most common, most accessible, and most testable causes of a single-cylinder misfire once fuel delivery and mechanical causes are confirmed normal.
33. **D. The vent tube for a restriction or blockage** — The vent solenoid is confirmed functioning correctly in both directions — it opens and drops tank pressure when commanded open, and it closes and holds pressure when commanded closed. With the solenoid itself confirmed functional in both directions, the fault generating the P0446 vent circuit code must be elsewhere in the vent path. The EVAP system monitor evaluates the vent circuit's ability to flow air freely when the solenoid is open — if the vent tube between the canister and atmosphere is restricted or blocked, the solenoid can open correctly but insufficient airflow moves through the vent path. The monitor detects inadequate vent flow despite a commanded-open solenoid and sets P0446. A physical inspection of the vent tube for blockage — debris, insect nest, crushed tubing — is the next appropriate step.
34. **B. A lean air-fuel mixture raising combustion temperature** — EGR is confirmed operating and flowing, and ignition timing is confirmed correct — two of the three primary NO_x causes are eliminated. LTFT at +14% on both banks at idle confirms the engine is running lean, with the PCM adding 14% more fuel than the base calculation to maintain stoichiometry. A lean combustion mixture burns at a higher peak temperature than a stoichiometric mixture — the reduced fuel mass relative to available oxygen shifts the flame temperature upward. NO_x formation increases exponentially with peak combustion temperature — even a moderate lean condition can produce significant NO_x elevation. The confirmed lean condition identified by the +14% bilateral LTFT is the direct cause of the elevated NO_x, and identifying the source of the lean condition is the appropriate next diagnostic step.

35. **C. Replace the bank 1 downstream O2 sensor — the open heater element confirms internal failure** — Supply voltage of 12.4 volts is confirmed at the heater supply wire — power delivery to the heater is intact. Ground resistance of 0.08 ohms is within the acceptable maximum — the ground circuit is correct. The heater element measuring OL — infinite resistance — on a DVOM confirms the heater element inside the sensor has an open circuit. The heater element is an integral part of the O2 sensor assembly and cannot be serviced separately. An open heater element means the sensor cannot reach operating temperature under its own power, preventing the sensor from generating an accurate voltage signal until it is heated by exhaust temperature alone — a process that takes much longer and may never occur at idle or light load. Sensor replacement is the only repair for a confirmed open internal heater element.
36. **B. The AIR pump output for a fault — rotation does not confirm adequate airflow** — Both check valves are confirmed open on both banks — the delivery path from the pump to the exhaust ports is mechanically clear. Neither upstream O2 sensor shows any lean response despite confirmed pump rotation and open check valves on both banks simultaneously. With the delivery paths confirmed open on both sides, the absence of any lean response on either bank confirms the pump is not generating adequate air volume despite mechanical rotation. A pump can rotate mechanically while producing negligible airflow due to a worn impeller, a slipping internal drive coupling, a severely clogged inlet filter, or a failed reed valve — all of which allow rotation while preventing adequate air delivery. Testing pump output pressure directly confirms whether the rotating pump is actually moving air.
37. **A. A worn AIR pump generating insufficient air volume and pressure** — The pump runs and check valves are confirmed open — the mechanical delivery system is intact. The upstream O2 sensors show a lean response confirming air is physically reaching the exhaust ports, but the lean excursion magnitude is below the PCM's minimum threshold for a monitor pass. A pressure test at the AIR manifold showing low output pressure — despite confirmed pump rotation and open check valves — directly confirms the pump is the restriction point. A worn pump with degraded impeller vanes, worn housing clearances, or a failing internal drive generates reduced pressure and reduced airflow volume despite mechanical operation. The reduced volume creates a detectable but sub-threshold lean response, producing the P0411 incorrect flow code while the system appears partially functional.

DOMAIN E — COMPUTERIZED ENGINE CONTROLS INCLUDING OBD II

38. **D. Fuel trims are within the normal operating range — no fault is indicated** — STFT at -1% and LTFT at -2% at idle with STFT at 0% and LTFT at -1% at 2,500 RPM represent minimal fuel corrections well within the accepted $\pm 10\%$ normal operating range on both banks at all engine speeds. The slight bilateral negative correction at idle normalizing at elevated RPM is a common normal variation — minor differences in idle airflow calculation accuracy at low MAF flow rates that normalize at higher airflow. No codes are stored and the values are consistent across both banks and both RPM conditions, confirming no bank-specific or speed-specific fault pattern. Near-

zero negative trims are as normal and diagnostically insignificant as near-zero positive trims when no other symptoms or codes accompany them.

39. **B. An exhaust manifold leak on bank 1 upstream of the O2 sensor** — Bank 2 LTFT near zero confirms all shared system components — MAF, fuel pressure, and EVAP — are functioning correctly. All bank 1 injectors pass the balance test, fuel pressure is correct, and a smoke test of the bank 1 intake reveals no vacuum leaks — eliminating fuel delivery and intake vacuum faults. With all intake-side and fuel-side causes confirmed absent, the bank 1 exclusive lean condition must originate from a source that introduces a false lean signal to the bank 1 sensing circuit. An exhaust manifold leak upstream of the bank 1 upstream O2 sensor draws atmospheric air into the exhaust stream — the sensor detects the elevated oxygen content and signals lean, driving the PCM to add fuel and generating the elevated positive LTFT exclusively on bank 1.
40. **C. Normal closed-loop correction from a base map that runs lean during open-loop warm-up** — STFT at +22% for the first 60 seconds of cold start reflects the PCM operating in open-loop mode, applying its fixed cold-start enrichment table without O2 sensor feedback. If the base open-loop enrichment map is calibrated slightly lean — delivering less fuel than the engine actually requires during cold open-loop operation — the STFT accumulates a large positive correction attempting to reach stoichiometry even before closed-loop entry. The immediate drop to +3% STFT upon closed-loop entry confirms the O2 sensors and closed-loop control are functioning correctly — the lean base map is corrected effectively once the PCM switches to sensor-guided fuel control. LTFT at +2% after the drive confirms the long-term average correction is minimal and the engine runs correctly under closed-loop control.
41. **B. Normal EVAP canister purge operation** — STFT at +2% and LTFT at +3% on both banks throughout idle and city driving confirms the base fuel delivery is slightly lean but near normal. The bilateral LTFT drop to -5% during highway driving — confirmed by the scan tool showing the EVAP monitor as active during the trim drop — is the expected fuel trim response to EVAP canister purge. When the PCM activates purge at highway cruise conditions, stored fuel vapors from the charcoal canister are drawn into the intake manifold, adding unmetered fuel to both banks simultaneously. The PCM responds by reducing fuel delivery — LTFT drops bilaterally — to compensate for the added vapor. The 3-minute duration and return to baseline when purge concludes, combined with confirmed EVAP monitor activity during the event, confirms normal purge operation.
42. **D. A vacuum leak providing uncontrolled bypass air** — Idle speed at 1,450 RPM — nearly double the 650–750 RPM specification — with a functionally correct IAC valve and a fully closing throttle plate confirmed by visual inspection rules out both the IAC hardware and a stuck throttle as causes. When the IAC and throttle plate are both confirmed correct, an idle speed above specification requires an alternate uncontrolled air source — a vacuum leak introducing unmetered air that bypasses both the throttle plate and the IAC circuit entirely. The PCM responds to the elevated RPM by commanding minimum IAC airflow, but it cannot reduce idle speed below the

level sustained by the vacuum leak. A hose off the intake manifold, a cracked brake booster hose, or a failed intake manifold gasket are common sources of the bypass air causing the elevated idle.

43. **C. A damaged or worn reluctor wheel tooth at that position** — A P0336 range/performance code confirms the PCM has detected an irregular signal pattern — not a complete absence of signal as would occur with a P0335 no-signal code. The scope confirms a signal is present and correct for most of the revolution, with one tooth position producing a consistently lower amplitude signal at the same crankshaft position every revolution. A tooth that has been physically damaged — chipped, worn down, or bent — has a reduced cross-sectional area that creates a smaller magnetic field change as it passes the sensor. This reduced field change generates a weaker induced voltage — a lower-amplitude signal — at that specific position on every revolution. The consistency at the same position every revolution confirms a fixed physical characteristic of the wheel rather than an electrical intermittent.
44. **A. Replace the bank 1 throttle body base gasket, clear codes, and verify LTFT normalizes** — The smoke test has directly identified the specific leak source — a seeping throttle body base gasket on bank 1. Bank 2 LTFT near zero confirms all shared system components are correct. The identified gasket leak is the cause of the bank 1 lean condition — replacing the gasket eliminates the unmetered air source. Clearing the P0171 code and confirming LTFT bank 1 returns to the normal range after a complete drive cycle verifies the repair resolved the fault. Replacing the upstream O2 sensor as a precaution is not indicated — a sensor contaminated by the lean condition typically recovers once the lean condition is corrected. Applying sealant to a leaking gasket is not a correct professional repair.
45. **D. The fuel tank has been filled above 85% capacity** — No codes are stored and the fuel cap seals correctly — confirming no active fault is preventing EVAP monitor execution. The catalyst, O2, and all other monitors are complete, confirming the vehicle has been driven sufficiently for most monitors to run. The EVAP monitor has uniquely specific enable criteria on most OBD II vehicles, including a requirement that the fuel level be between approximately 15% and 85% of tank capacity. With a full or near-full tank, the EVAP monitor's fuel level enable condition is not satisfied and the monitor cannot begin its evaluation cycle regardless of how many miles are driven or how correctly all other systems are functioning. Advising the customer to drive the vehicle with the fuel level below the 85% threshold is the appropriate guidance.
46. **B. A cold-sensitive intake manifold gasket or rubber component that shrinks below a specific temperature** — The misfire and elevated LTFT occur only during cold ambient temperatures — a direct thermal correlation that identifies a temperature-responsive material as the fault source. Rubber and elastomeric gasket materials contract as temperature decreases, and a component that is marginal at normal temperatures may crack, stiffen, or pull away from its seating surface sufficiently at cold temperatures to create a vacuum leak that disappears as the engine warms. A smoke test performed cold is the appropriate confirmation test — a standard smoke test during warm operation would find nothing because the leak seals as the engine reaches operating

temperature. The +3% warm LTFT confirms no persistent lean condition exists when the rubber component has expanded back to its sealing dimensions.

47. **C. The MAF sensor for an internal failure** — Supply voltage of 12.3 volts and ground resistance of 0.1 ohms are both confirmed correct — the sensor's external circuit is intact. A new air filter confirms no airflow restriction. A MAF signal voltage of 0.3 volts against a 0.9–1.1 volt idle specification — combined with LTFT at +31% on both banks — confirms a severely underreporting sensor causing a massive bilateral lean condition. With the external circuit confirmed correct — correct power, correct ground, unobstructed airflow — the fault must be internal to the sensor. The hot-wire sensing element may be contaminated or the signal conditioning circuit within the sensor may have failed, but with all external factors confirmed correct, the sensor itself is the most likely fault and should be replaced as the next diagnostic step.
48. **A. The catalyst has nearly failed — the pending code and Mode 6 value together confirm imminent converter failure** — A pending P0420 code indicates the catalyst monitor failed its most recent evaluation — the downstream sensor switching pattern crossed the failure threshold on the last monitor run, but a second consecutive failure is required to illuminate the MIL and set a confirmed code. Mode 6 data showing the test value at 97% of the maximum allowed threshold confirms the catalyst efficiency is critically close to the failure boundary. The combination of a pending code — confirming the monitor already failed once — and a Mode 6 value at 97% of threshold — confirming the efficiency is nearly at the failure limit — together provide sufficient evidence that the catalytic converter has lost most of its oxygen storage capacity and requires replacement before the MIL illuminates on the next monitor evaluation.
49. **D. An intermittent leaking bank 1 injector that passes the balance test but seeps between test intervals** — All bank 1 injectors pass the balance test within 3%, confirming correct commanded delivery volume. MAF is confirmed correct and fuel pressure is correct, eliminating metering and pressure faults. Bank 2 LTFT at +2% confirms no shared system fault. The bank 1 upstream O2 sensor switches normally between 0.1 and 0.9 volts at the correct rate — confirming it is accurately reflecting the actual exhaust composition rather than outputting a contaminated fixed signal. A sensor switching correctly with LTFT at -21% confirms the rich condition is real — excess fuel is actually entering the bank 1 cylinders. With commanded delivery confirmed correct by the balance test, an injector leaking between commanded events — through a worn needle seat that allows fuel to drip when the injector is electrically closed — is the most likely undetected fuel source.
50. **A. The EVAP purge system is functioning and delivering fuel vapor when commanded** — LTFT of +3% and +4% on both banks at baseline confirms the base fuel delivery is slightly lean but near normal. Commanding the EVAP purge solenoid open via bi-directional test causes LTFT to drop bilaterally to -6% within 2 minutes — the PCM is reducing fuel delivery by approximately 10% to compensate for the fuel vapor being added through the purge solenoid. Commanding purge off causes LTFT to recover to the +4% baseline — confirming the vapor contribution stops when the solenoid closes and the PCM resumes normal fuel delivery. This controlled response to a

commanded on-off purge cycle confirms the EVAP purge solenoid is mechanically opening and closing correctly, the charcoal canister has stored fuel vapor available for delivery, and the fuel trim response confirms the vapor is reaching the intake manifold and being detected by the O2 sensors.