PRACTICE EXAM 20: 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 steady reading of 16 in/Hg. At 2,500 RPM under no load, the needle holds steady at 16 in/Hg — no change from the idle reading. What does this MOST likely indicate?

A. Severely retarded ignition timing — the vacuum does not rise at elevated RPM because the timing fault prevents improved pumping efficiency

B. A large vacuum leak reducing available manifold vacuum at all engine speeds equally

C. Restricted exhaust flow preventing the engine from building additional vacuum at elevated RPM

D. Worn piston rings reducing pumping efficiency equally at idle and elevated RPM under no load

2. A compression test on a 4-cylinder engine shows cylinder 1 at 155 psi, cylinder 2 at 158 psi, cylinder 4 at 160 psi, and cylinder 3 at 80 psi dry and 145 psi wet. What does the wet test result on cylinder 3 confirm?

A. Worn or damaged piston rings on cylinder 3 — the significant wet test improvement confirms the rings as the leak path

B. A burned valve on cylinder 3 — the wet test improvement confirms combustion gas is escaping past the valve seat

C. A head gasket breach on cylinder 3 — the wet test improvement is characteristic of a gasket leak between cylinders

D. Carbon deposits reducing cylinder 3 compression — the wet test clears the deposits temporarily improving the reading

3. An engine has a rough idle and a P0300 random misfire code. A cylinder contribution test is performed. All cylinders drop 185–210 RPM when disabled except cylinder 4, which drops only 20 RPM. What does the minimal RPM drop on cylinder 4 confirm?

A. The cylinder 4 spark plug is fouled — the minimal contribution confirms ignition failure on that cylinder

B. The cylinder 4 injector is restricted — the minimal drop confirms fuel delivery is insufficient on that cylinder

C. The cylinder 4 compression is low — the minimal contribution reflects reduced mechanical output from that cylinder

D. Cylinder 4 is contributing minimally to engine output — the cause must be confirmed with further testing of ignition, fuel, and compression

4. An engine produces a light, rapid tapping from the valve train area that is present at all temperatures and all RPM. The tap does not change with engine load. Oil pressure is normal and oil level is correct. What is the MOST likely cause?

A. A hydraulic lifter that has bled down — the tap would disappear within 30 seconds of startup if bleed-down were the cause

B. Excessive valve clearance on one or more valves — a mechanical clearance tap is constant at all temperatures and loads and does not respond to oil pressure changes

C. A worn camshaft lobe producing reduced lift and a secondary impact at the follower — the constant tap at all conditions confirms cam lobe wear

D. A loose rocker arm retaining nut allowing the rocker to move independently of the valve stem — the tap would change with load if the retainer were loose

5. A cylinder leakage test on all cylinders shows 3–6% leakage on cylinders 1, 2, 3, and 4. Cylinder 5 shows 42% leakage. Air is heard escaping from the throttle body air inlet. What does air escaping from the throttle body air inlet indicate?

A. The intake valve on cylinder 5 is not sealing — air pushed past the open or damaged intake valve exits through the intake manifold toward the throttle body

B. The exhaust valve on cylinder 5 is not sealing — air is traveling through the exhaust system and re-entering the intake through a crossover passage

C. The head gasket on cylinder 5 is breached between the combustion chamber and an intake manifold passage

D. The piston rings on cylinder 5 are worn — air entering the crankcase is routed to the intake through the PCV system

6. An engine at operating temperature has a vacuum gauge showing a steady 19 in/Hg at idle. The technician rapidly opens and closes the throttle. The needle drops sharply to zero at snap-throttle, rises to 25 in/Hg on the rebound, then settles back to 19 in/Hg. What does this confirm?

A. Retarded ignition timing — the snap-throttle rebound above baseline confirms a timing fault

B. A weak valve spring — the 25 in/Hg rebound above normal confirms a spring bouncing the valve closed

C. Normal engine mechanical condition — a sharp drop to zero, rebound above baseline, and return to normal idle vacuum is the expected response for a mechanically sound engine

D. Restricted exhaust — the rebound to 25 in/Hg confirms backpressure converting to a momentary vacuum surge on throttle closing

7. An engine has a knocking sound specifically during cold start that transitions from a loud knock to a lighter tick within the first 20 seconds of operation. Oil level and pressure are normal. What is the MOST likely cause?

A. A worn timing chain that tightens with thermal expansion of the chain guides during warm-up

B. A worn main bearing that produces a knock when cold oil is thin and transitions to a tick as viscosity increases

C. Carbon deposits on the piston crown producing cold-start detonation that clears as the deposits heat up

D. Piston-to-bore clearance that is excessive when cold, producing a loud slap that decreases as the aluminum piston expands with heat

8. A no-start condition exists on a port injection engine. Fuel pressure is 55 psi. Compression is 162 psi on all cylinders. Spark is confirmed at all cylinders. A noid light confirms injector pulse on all cylinders. Cranking the engine with the throttle held to the floor produces no change. What should the technician check NEXT?

A. The crankshaft position sensor signal quality — a CKP with correct pulse but incorrect timing reference prevents combustion

B. The injector spray pattern for a fault delivering fuel in a solid stream rather than an atomized spray

C. The camshaft position sensor for a fault preventing the PCM from correctly sequencing injection events

D. The throttle position sensor for a wide-open throttle enrichment fault that is flooding the engine during cranking

8. No-start. Fuel pressure, compression, spark, and injector pulse are all confirmed. Cranking with throttle to the floor produces no change. What should the technician check NEXT?

A. The CKP signal quality for a timing reference fault

B. The injector spray pattern for a non-atomizing fault

C. The CMP sensor for a fault preventing correct injection sequencing

D. The TPS for a WOT enrichment fault flooding the engine

9. A cooling system pressure test holds 16 psi for 30 minutes with no drop. Coolant level drops 1 quart every 500 miles with no visible external leaks or puddles. No combustion gases are found in the coolant on a chemical block test. What should the technician check NEXT?

A. The oil for a milky or emulsified appearance — coolant entering the oil through an internal gasket breach with no combustion gas crossover can produce coolant loss with no external evidence

B. The overflow reservoir for a cracked internal baffle allowing coolant to bypass the pressure relief point

C. The radiator cap for a faulty pressure relief valve releasing coolant at below-specification pressure

D. The water pump impeller for cavitation causing coolant to vaporize internally before reaching the overflow

10. An engine has a misfire that occurs only at highway cruise speed and load and is absent at idle, light throttle, and WOT. Compression, fuel pressure, and idle ignition waveforms are all confirmed normal. LTFT is +2% on both banks. What should the technician check FIRST?

A. The EGR valve for a stuck-closed condition preventing dilution at cruise conditions that requires it

B. The MAF sensor for a cruise-speed contamination fault causing lean delivery only at highway airflow rates

C. The ignition system under load at cruise RPM — a coil or plug wire that passes at idle may break down under the sustained high-voltage demand of highway cruise

D. The fuel injectors for a cruise-speed restriction that causes lean delivery only at the sustained pulse width of highway load

11. A relative compression test is performed. Cylinders 1, 2, 3, and 4 show consistent crank speed and consistent amperage pull. Cylinder 5 shows normal crank speed but an amperage trace that drops to nearly zero during the compression stroke. What does a near-zero amperage during the compression stroke on cylinder 5 indicate?

A. Cylinder 5 has no compression — the starter motor encounters no resistance during the compression stroke, drawing minimal current

B. A CKP signal error at the cylinder 5 position — the tester misidentifies the compression stroke

C. The cylinder 5 intake valve is stuck open — intake air bleeds back rather than compressing, reducing amperage

D. The cylinder 5 piston has seized — the tester registers no stroke resistance because the piston is not moving

12. An engine has oil consumption of 1 quart per 800 miles. No external leaks. No blue smoke at any condition. PCV is functional. Compression and leakage are confirmed normal. The technician performs a cylinder oil contribution test by removing each spark plug after a highway run and inspecting for oil contamination. Cylinders 1 through 7 plugs are dry. Cylinder 8 shows a wet, oily deposit on the plug and insulator. What does this indicate?

A. Worn piston rings on cylinder 8 — the oil on the plug confirms ring blow-by past the oil control ring

B. A failed PCV system specifically routed to cylinder 8 — the PCV routes oil mist directly into that cylinder

C. Worn or failed valve stem seals on cylinder 8 — localized oil consumption on one cylinder with confirmed normal compression and leakage points to the valve stem path

D. A head gasket breach at cylinder 8 allowing oil to enter the combustion chamber from the lubrication passages

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

13. A spark plug removed from a cylinder shows a white or light gray insulator with blistering, erosion of the electrode tip, and rounded electrode edges. What does this indicate?

A. Carbon fouling — the white insulator and electrode erosion confirm excessive rich operation

B. Overheating or pre-ignition damage — the white blistered insulator and eroded electrode confirm operation above the plug's thermal range

C. Normal wear — a white insulator with some electrode erosion is expected at the end of the plug's service life

D. Oil fouling — the blistering is caused by oil combustion at high temperature on the insulator surface

14. A secondary ignition waveform shows a normal firing line and a spark line on all cylinders except one, which shows an extremely high firing line — significantly above all other cylinders — followed by a very brief spark line. What does an abnormally high firing line on one cylinder MOST likely indicate?

A. A weak coil on that cylinder requiring excessive voltage to initiate the arc due to low stored energy

B. A fouled spark plug on that cylinder creating a conductive path that reduces the firing line requirement

C. A high-resistance plug wire on that cylinder requiring more voltage to overcome the wire resistance before the plug fires

D. A faulty ignition module causing excessive dwell time on that cylinder and overcharging the coil

15. A COP system produces a confirmed misfire on cylinder 3. The cylinder 3 coil is swapped with cylinder 7. After a test drive, P0303 does not return and P0307 sets. What does this confirm?

A. The cylinder 3 spark plug is the fault source — the plug went with the coil to cylinder 7

B. The cylinder 3 PCM driver circuit has failed — the misfire moved because the driver follows the coil position

C. The cylinder 3 coil has failed — the misfire moved with the coil to the cylinder 7 position

D. Both the coil and the spark plug on cylinder 3 have failed — both components traveled with the swap

16. A Hall effect CMP sensor is tested. The sensor produces a clean 0–5 volt square wave signal. However, the signal is missing one expected pulse per camshaft revolution at the same position every revolution. No codes are stored. What is the MOST likely cause?

A. A missing or damaged tooth on the camshaft trigger wheel at that position — the absent tooth produces no switching event, creating the absent pulse

B. The PCM input filter is blocking one pulse per revolution at its programmed signal frequency

C. An intermittent open in the sensor signal wire occurring once per revolution from a harness flex point

D. The Hall effect sensor element is degrading and intermittently fails to detect one tooth per revolution

17. A DIS system has confirmed misfires on cylinders 2 and 5 — a paired coil. The coil is replaced. After the repair, the misfire on cylinder 2 is resolved but cylinder 5 still misfires. What should the technician check NEXT on cylinder 5?

A. The PCM driver circuit for the cylinder 2/5 coil position — a driver fault may have caused the original coil failure

B. The plug wire routing for cylinder 5 for proximity to a heat source causing intermittent insulation breakdown

C. The spark plug and compression on cylinder 5 — with the shared coil confirmed good, the fault is isolated to cylinder 5-specific components

D. The fuel injector on cylinder 5 for a restriction causing a lean misfire that the coil replacement could not resolve

18. A magnetic reluctance CKP sensor is tested with a lab scope during cranking. The waveform shows normal tooth amplitude on most teeth. However, one tooth per revolution shows a significantly higher amplitude than all others — approximately double the normal amplitude. What is the MOST likely cause?

A. A ferrous deposit or chip adhered to one reluctor tooth — the added ferrous material increases the magnetic field change as that tooth passes the sensor

B. An intermittent short to the sensor reference voltage at that crankshaft position inflating the signal at that point

C. The PCM is injecting a reference pulse at that crankshaft position to establish a timing reference — the high-amplitude pulse is intentional

D. The CKP sensor element is magnetically saturating at that tooth position due to a localized field strength anomaly

19. A technician performs a coil primary waveform test on a COP system. On one cylinder, the primary waveform shows normal voltage during dwell and a normal firing line. However, the oscillation pattern after the firing line shows only one or two dampened oscillations before going flat, compared to the four to six oscillations seen on all other cylinders. What does reduced post-firing oscillation indicate?

A. The coil secondary winding has low resistance — the reduced oscillation confirms current dissipation through a partial winding short

B. A high-resistance condition in the secondary circuit — a resistive secondary circuit dampens the oscillation by absorbing available resonant energy

C. Normal variation — post-firing oscillation count varies between cylinders based on mixture and combustion conditions

D. The coil primary winding has excessive resistance — primary resistance dampens the resonant oscillation after firing

19. A COP primary waveform shows normal dwell and firing line but only one or two post-firing oscillations versus four to six on all other cylinders. What does reduced post-firing oscillation indicate?

A. Low secondary winding resistance — a partial winding short dissipates post-firing energy

B. A high-resistance condition in the secondary circuit — a resistive secondary dampens the resonant oscillation

C. Normal variation between cylinders based on combustion conditions

D. Excessive primary winding resistance dampening the resonant oscillation after firing

20. A technician is testing ignition timing with a timing light on a distributor ignition system. The base timing specification is 10° BTDC with the timing advance connector unplugged. With the connector unplugged, timing reads 22° BTDC. What should the technician check FIRST?

A. The distributor position — the distributor may have been rotated from its correct position, advancing timing 12° beyond specification

B. The ignition module for a fault advancing timing beyond PCM command when the advance connector is unplugged

C. The vacuum advance unit for a leak causing mechanical timing advance independent of the advance connector

D. The PCM for a fault sending an advance command despite the timing connector being unplugged

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

21. A port injection engine has fuel pressure of 45 psi at idle against a specification of 55–60 psi. At key-on with the engine off, pressure builds to 55 psi and holds. With the engine running at idle, pressure drops to 45 psi. With the vacuum line removed from the pressure regulator at idle, pressure rises to 55 psi. What does this confirm?

A. A weak fuel pump — the pump cannot maintain pressure against the running engine's fuel demand

B. A correctly functioning fuel pressure regulator responding normally to manifold vacuum — the pressure drop at idle is vacuum-referenced regulation, not a fault

C. A fuel pressure regulator diaphragm leak — vacuum is pulling fuel through the diaphragm and into the intake manifold

D. A restricted fuel filter causing pressure drop under the increased flow demand of engine operation

22. A scan tool at idle shows LTFT at +12% on bank 1 and -1% on bank 2. At 2,500 RPM, bank 1 LTFT drops to +3% and bank 2 remains at -1%. A smoke test of the bank 1 intake reveals no leaks. All bank 1 injectors pass a balance test. What should the technician check NEXT?

A. The bank 1 MAF sensing element for contamination causing an idle-specific underread on bank 1

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

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

D. The bank 1 fuel pressure regulator for a fault causing low pressure delivery specifically to bank 1

23. A return-style fuel system shows fuel pressure of 57 psi at idle. The vacuum reference line is disconnected and plugged. Pressure rises to 63 psi. The specification without vacuum reference is 58–65 psi. What does this confirm?

A. The fuel pressure regulator is functioning correctly — pressure within specification without vacuum confirms normal regulator calibration

B. The fuel pressure regulator diaphragm is ruptured — the rise in pressure without vacuum confirms the diaphragm cannot regulate correctly

C. The fuel pump is over-delivering without the vacuum reference — the higher pressure confirms pump overcapacity

D. The fuel filter is partially restricted — removing vacuum reference causes a pressure rise that confirms filter restriction

24. A GDI engine at idle shows high-pressure rail pressure of 1,850 psi — within specification. A scope of the high-pressure pump cam follower shows the follower stroke is within specification. Under cold-start conditions only, the engine misfires for the first 5–10 seconds. High-pressure rail pressure during cold start drops to 300 psi. What is the MOST likely cause?

A. Multiple leaking high-pressure injectors bleeding the rail during the cold-start enrichment pulse width

B. The low-pressure pump not reaching operating pressure fast enough during cold start, starving the high-pressure pump

C. The high-pressure pump pressure relief valve opening prematurely under cold oil viscosity conditions

D. The high-pressure pump volume control valve failing to regulate correctly under cold oil viscosity, producing insufficient pressure during cold start

25. A naturally aspirated engine has LTFT at +3% on both banks at idle and cruise. During deceleration with a closed throttle at highway speed, LTFT spikes to +22% on both banks for 3–4 seconds before returning to +3% as vehicle speed decreases. No codes are stored. What is the MOST likely cause?

A. The EVAP purge solenoid closing during deceleration and causing a sudden lean condition

B. The upstream O2 sensors going lean during deceleration fuel cut, producing a momentary LTFT response the PCM logs as a trim event

C. A vacuum leak that is amplified during the high vacuum of closed-throttle deceleration

D. Normal deceleration fuel cut behavior — the PCM reduces injector pulse width to near zero during closed-throttle deceleration, causing the O2 sensors to read lean and driving momentary positive STFT values that are logged as LTFT spikes

25. LTFT is +3% on both banks at idle and cruise but spikes to +22% bilaterally for 3–4 seconds during closed-throttle deceleration before returning to +3%. No codes are stored. What is the MOST likely cause?

A. The EVAP purge solenoid closing during deceleration causing a sudden lean condition

B. The upstream O2 sensors going lean during deceleration fuel cut, producing a momentary trim response

C. A vacuum leak amplified under the high vacuum of closed-throttle deceleration

D. Normal deceleration fuel cut — near-zero injector pulse width causes O2 sensors to read lean, driving momentary STFT values logged as a spike

26. A turbocharged engine has a P0299 underboost code. Boost pressure at WOT peaks at 4 psi against a 12 psi specification. The turbocharger compressor wheel spins freely with no blade damage. The wastegate actuator rod moves freely. A boost leak test under shop air reveals no leaks in the charge air circuit. What should the technician check NEXT?

A. The turbocharger turbine side for carbon buildup restricting exhaust flow through the turbine housing

B. The wastegate for a stuck-open condition preventing boost pressure from building despite correct compressor function

C. The boost pressure sensor for a reading fault causing incorrect boost reporting without affecting actual pressure

D. The intercooler core for internal restriction reducing charge air volume reaching the throttle body

27. A port injection engine has rough idle and LTFT at +18% on both banks. A large vacuum leak is found at a cracked intake manifold gasket. After gasket replacement, the engine idles smoothly. What should the technician do NEXT before returning the vehicle?

A. Clear the fault codes and LTFT adaptive memory, then verify LTFT normalizes to within ±5% after a complete drive cycle

B. Replace the upstream O2 sensors — a large vacuum leak contaminates sensors and replacement is required after a major intake repair

C. Perform a smoke test to confirm no additional leaks before clearing codes

D. Replace the MAF sensor — extended operation with a large vacuum leak causes MAF contamination requiring replacement

28. A vehicle has 3.8 psi exhaust backpressure at 2,500 RPM against a 3.0 psi maximum. The catalytic converter was confirmed intact by visual inspection. A backpressure test upstream of the converter shows 1.0 psi — within normal limits. A backpressure test between the converter and the muffler shows 3.8 psi. What is confirmed by these results?

A. The catalytic converter is the restriction — normal upstream and elevated mid-pipe pressure isolates the converter

B. The catalytic converter has already been eliminated — mid-pipe pressure of 3.8 psi with normal upstream confirms the muffler is the restriction

C. The flex pipe between the manifold and converter is the restriction — the upstream test point is downstream of the flex pipe

D. Both the converter and muffler contribute equally — split pressure testing is needed to confirm the individual contribution of each component

29. A vehicle has a P0087 fuel rail pressure low code on a returnless fuel system. Fuel pressure at idle is 44 psi against a 58–62 psi specification. A new fuel pump module is installed. Fuel pressure at idle after the repair is 48 psi — still below specification. What should the technician check NEXT?

A. The fuel pressure sensor for a reading fault causing an incorrect low pressure display despite correct actual pressure

B. The fuel injectors for internal leakage bleeding rail pressure below specification despite correct pump output

C. The fuel pump relay for a contact resistance fault causing voltage drop to the new pump and limiting output

D. The fuel rail for a restriction reducing pressure at the rail sensor location despite correct pump output

29. P0087 fuel pressure low on a returnless system. New pump installed. Pressure is still 48 psi against a 58–62 psi specification. What should the technician check NEXT?

A. The fuel pressure sensor for a reading fault

B. The fuel injectors for internal leakage bleeding rail pressure

C. The fuel pump relay for contact resistance causing voltage drop to the pump

D. The fuel rail for a restriction reducing pressure at the sensor location

30. A vehicle has correct idle fuel pressure. Under a WOT acceleration run, fuel pressure holds within 3 psi of idle pressure throughout. LTFT is +18% on both banks at all conditions. What does stable fuel pressure during WOT with high positive LTFT indicate?

A. A large vacuum leak — stable WOT pressure with high positive trims confirms unmetered air rather than a fuel delivery fault

B. A fuel volume delivery fault — stable pressure confirms the pump can maintain pressure but high LTFT confirms volume is insufficient for actual fuel demand

C. A MAF sensor over-reading — stable pressure with positive trims confirms the MAF is overcalculating airflow and under-delivering fuel

D. Simultaneous injector restriction — stable pressure with high positive trims on both banks confirms bilateral injector flow faults

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

31. A PCV valve is tested by placing a finger over the inlet with the engine at idle. No vacuum is felt at the inlet. The PCV hose between the valve and the intake manifold is confirmed unobstructed. Manifold vacuum at the intake connection is 18 in/Hg. What should the technician check NEXT?

A. The fresh air inlet hose for a blockage preventing crankcase ventilation airflow

B. The intake manifold PCV port for a carbon restriction blocking vacuum from reaching the PCV valve

C. The PCV valve grommet for an air leak bypassing the valve and reducing effective vacuum

D. The PCV valve for an internal fault — a PCV valve that passes no vacuum at idle with confirmed manifold vacuum is stuck closed or internally obstructed

31. Finger placed over PCV inlet at idle feels no vacuum. PCV hose is clear. Manifold vacuum at intake connection is 18 in/Hg. What should the technician check NEXT?

A. The fresh air inlet hose for a blockage

B. The intake manifold PCV port for carbon restriction

C. The PCV valve grommet for an air leak

D. The PCV valve for a stuck-closed or internally obstructed condition

32. A vehicle fails an emissions test with elevated CO and HC, and low O2 at the tailpipe. LTFT is -14% on both banks. No codes are stored. What does the combination of elevated CO, elevated HC, low O2, and high negative LTFT indicate?

A. A lean misfire — low O2 confirms excess oxygen in the exhaust from incomplete combustion

B. A rich mixture — CO and HC are products of incomplete rich combustion; low O2 confirms the excess fuel is consuming available oxygen; negative LTFT confirms the PCM is already reducing fuel

C. A degraded catalytic converter — the converter is not oxidizing CO and HC to acceptable levels

D. An exhaust manifold leak — outside air is diluting the exhaust and causing incorrect emissions readings

33. A vehicle has a P0456 small EVAP leak stored. The fuel cap seals correctly. A standard smoke test reveals no leaks. A low-pressure smoke test reveals a very small seep at the EVAP vent solenoid body. The vent solenoid is commanded closed during the test. What is the correct repair?

A. Clear the code and retest — a seep at the vent solenoid body below standard smoke test detection is within acceptable EVAP tolerance

B. Reseat the vent solenoid connector and retest — a poor electrical connection can produce a false leak indication

C. Apply EVAP-rated sealant to the seep and confirm with a low-pressure retest

D. Replace the EVAP vent solenoid and retest with low-pressure smoke to confirm the repair

34. A vehicle has a P0401 insufficient EGR flow code. The EGR valve is commanded open on a bi-directional test and actuates. At 2,500 RPM with the valve commanded open, MAP increases by 3 kPa. The specification for MAP change with EGR open is 8–12 kPa. What does a below-specification MAP change with confirmed valve movement indicate?

A. The EGR passages are partially carbon-restricted — the valve opens but restricted flow produces insufficient manifold pressure change

B. The MAP sensor has low sensitivity — the actual MAP change is within specification but the sensor underreports it

C. The EGR valve is opening to a reduced position — the actuator confirms movement but the valve does not open fully

D. Normal EGR function — MAP change varies with RPM and 3 kPa at 2,500 RPM is within the expected range

35. A vehicle has a P0135 upstream O2 sensor heater circuit fault on bank 1. The heater element resistance measures 10.2 ohms — within the 8–12 ohm specification. Heater supply voltage at the sensor connector is 12.6 volts. The PCM heater control ground measures 11.4 volts — referenced to battery negative. What does the 11.4-volt reading on the PCM heater control ground confirm?

A. The PCM heater ground circuit is functioning correctly — 11.4 volts confirms the ground driver is active

B. The heater element has an intermittent open — the 11.4-volt reading reflects a floating circuit with no current path

C. The PCM heater control ground has 11.4 volts of voltage drop — the ground circuit has high resistance preventing current flow and generating the heater circuit fault

D. The heater supply circuit has a short to ground — supply voltage appears on the ground circuit confirming a wiring fault

36. An AIR pump cold start test is performed. The pump runs for the full 30 seconds. Both upstream O2 sensors show a strong lean response for the first 15 seconds. Both sensors then transition to a rich voltage for the remaining 15 seconds of pump operation with the pump still running. What does the rich transition while the pump is still running indicate?

A. Both upstream O2 sensor heaters activated and brought the sensors to operating temperature, allowing them to detect normal rich cold-start combustion

B. The AIR pump check valves closed bilaterally — the lean response ends when the valves shut and the sensors detect the normal cold-start rich mixture without air injection

C. The AIR pump lost output — the lean response ends when the pump output drops below the detection threshold and raw combustion chemistry returns

D. The PCM commanded rich enrichment during the AIR test — the rich transition is a calibration event, not an AIR system fault

37. A vehicle has a P0430 catalyst efficiency low code on bank 2. The bank 2 downstream O2 sensor switches at 0.9 cycles per second. The bank 2 upstream sensor switches at 1.0 cycles per second. LTFT bank 2 is -1%. Backpressure downstream of the bank 2 converter is 1.4 psi. What is the correct interpretation?

A. The backpressure confirms the bank 2 converter substrate is intact — the P0430 is a false positive

B. A downstream O2 sensor switching at nearly the same rate as the upstream confirms the bank 2 converter has essentially no remaining oxygen storage capacity — the P0430 is valid

C. The slight switching rate difference with normal backpressure confirms some remaining converter efficiency — the downstream sensor should be tested before condemning the converter

D. The LTFT at -1% confirms the bank 2 mixture is slightly rich — the P0430 may be caused by the rich mixture reducing converter efficiency rather than converter failure

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 and cruise. No codes are stored. All monitors are complete. What is the correct interpretation?

A. A leaking injector on both banks — bilateral negative trims indicate excess fuel delivery

B. Normal fuel control operation — trims within ±10% on both banks at all conditions with no codes require no action

C. The MAF sensor is over-reading — bilateral negative trims at all speeds confirm MAF over-reporting

D. The upstream O2 sensors are rich-biased — bilateral negative trims confirm contaminated sensors

39. A vehicle has STFT at +2% and LTFT at +3% on bank 1. Bank 2 STFT is +1% and LTFT is +2%. During a bi-directional EVAP purge test, both banks' LTFT drop to -5% within 60 seconds and return to baseline when purge is commanded off. What does this confirm?

A. A stuck-open EVAP purge solenoid — the LTFT drop confirms it was already open before the command

B. The charcoal canister is saturated — a -5% LTFT drop confirms excess vapor delivery from an overloaded canister

C. A fuel pressure increase during the purge test — the LTFT drop is caused by pressure change rather than vapor delivery

D. The EVAP purge solenoid is functioning correctly — the commanded open delivers vapor, drops LTFT, and the close restores baseline

39. During a bi-directional EVAP purge test, both banks' LTFT drop from +2–3% to -5% and return to baseline when purge is commanded off. What does this confirm?

A. A stuck-open purge solenoid — the LTFT drop confirms it was already open before the command

B. A saturated charcoal canister causing excess vapor delivery

C. A fuel pressure increase during purge causing LTFT drop

D. The purge solenoid is functioning correctly — vapor delivery drops LTFT and solenoid closing restores baseline

40. A vehicle has LTFT at -18% on bank 1 and +2% on bank 2. All bank 1 injectors pass a balance test. MAF is confirmed correct. Fuel pressure is confirmed correct. A scope of the bank 1 upstream O2 sensor shows it switching normally between 0.1 and 0.9 volts. What should the technician check NEXT?

A. The bank 1 fuel pressure regulator for a fault causing localized over-pressurization of bank 1 injectors

B. The bank 1 upstream O2 sensor for a rich-biased contamination fault — a sensor can switch normally while still being biased toward rich output

C. An exhaust manifold leak downstream of the bank 1 O2 sensor — a downstream leak on a rich-correction bank would cause lean readings, not rich

D. The EVAP purge solenoid for preferential vapor delivery to bank 1 causing the persistent rich correction

40. LTFT is -18% on bank 1 and +2% on bank 2. Injector balance, MAF, fuel pressure, and bank 1 O2 sensor switching are all confirmed normal. What should the technician check NEXT?

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

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

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

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

41. A vehicle has a P0113 IAT sensor high voltage code. The IAT reads -38°F in a 70°F shop. A DVOM at the IAT signal wire reads 4.95 volts. The PCM reference voltage is 5.0 volts. What does the 4.95-volt signal reading confirm?

A. The IAT signal circuit has an open — a near-reference voltage on the signal wire with no sensor pull-down confirms the sensor circuit is open between the sensor and PCM

B. The IAT sensor is reading correctly — 4.95 volts corresponds to a very cold temperature and confirms sensor accuracy

C. The PCM reference voltage has dropped — 4.95 volts instead of 5.0 confirms a reference circuit fault affecting all sensors on that reference line

D. The IAT sensor has a short to the reference circuit — the near-5-volt signal confirms the sensor signal wire is contacting the reference wire

42. A vehicle has an intermittent P0172 rich code on bank 1 that sets only after extended highway driving. LTFT bank 1 builds progressively from +2% at the start of the drive to -15% after 45 minutes. LTFT bank 2 remains at +2% throughout. Fuel pressure and injector balance are confirmed correct. What is the MOST likely cause?

A. An EVAP purge solenoid that opens more as canister vapor increases with temperature during extended driving

B. The bank 1 upstream O2 sensor developing a rich bias as it reaches thermal equilibrium during extended highway operation

C. A fuel pressure regulator that loses vacuum reference under sustained highway cruise, causing progressive pressure increase on bank 1

D. A bank 1 coolant temperature sensor drifting rich with extended heat exposure, causing progressive over-enrichment

43. A scan tool shows IAC valve commanded at 85% during idle. The idle specification is 700 RPM. Actual idle is 550 RPM. The throttle plate is confirmed closing fully. A smoke test reveals no vacuum leaks. What does an IAC command of 85% with a below-specification idle indicate?

A. The IAC valve driver circuit has high resistance — a high command with low RPM confirms the signal is not reaching the valve correctly

B. The IAC passage in the throttle body is carbon-restricted — the PCM is commanding maximum airflow but the restriction prevents enough air from reaching the intake to sustain the specified idle

C. The IAC valve has failed open — a valve stuck open would produce a high idle, not a low idle

D. The throttle body bore has a coating preventing correct airflow — the PCM is over-commanding the IAC to compensate

44. A vehicle has a P0340 CMP sensor circuit fault. The CMP sensor reference voltage is 5.0 volts. The CMP sensor ground resistance measures 0.1 ohms. The CMP signal wire reads 5.0 volts at rest with the sensor connected. No switching occurs during cranking. What does 5.0 volts on the signal wire with no switching during cranking indicate?

A. The CMP sensor ground is open — a sensor with an open ground produces 5.0 volts on the signal wire with no switching

B. The CMP trigger wheel has no teeth — the absence of teeth produces no switching despite correct voltage and ground

C. The CMP sensor has an open signal wire — the reference voltage appears on the signal wire through the sensor internal circuit

D. The signal wire has a short to the 5-volt reference — the signal wire is held at 5 volts by the short regardless of sensor output

44. P0340 CMP sensor circuit fault. Reference is 5.0 volts. Ground is 0.1 ohms. Signal wire reads 5.0 volts at rest with sensor connected and no switching occurs during cranking. What does this indicate?

A. The CMP sensor ground is open — an open ground produces 5.0 volts on the signal wire with no switching

B. The CMP trigger wheel has no teeth — no teeth produce no switching despite correct voltage and ground

C. The CMP sensor has an open signal wire — reference voltage appears through the internal circuit

D. The signal wire has a short to the 5-volt reference holding it at 5 volts regardless of sensor output

45. A vehicle has all OBD II monitors complete with no codes. STFT and LTFT are within ±3% on both banks. The customer reports poor fuel economy — 20% worse than the EPA rating over the past 2 months. No drivability symptoms. What is the MOST appropriate first diagnostic step?

A. Perform a fuel injector flow test and review Mode 6 data for parameters approaching fault thresholds that could indicate subtle over-delivery

B. Perform a compression test — a gradual mechanical efficiency loss producing poor fuel economy without drivability symptoms suggests developing ring or valve wear

C. Test the fuel pressure regulator under load — a rich pressure fault causing over-delivery may not trigger codes if the O2 sensors can compensate within trim limits

D. Replace the upstream O2 sensors — extended sensor life causes calibration drift toward rich output, causing over-fueling without a P013X code

46. A vehicle has a P0128 coolant temperature below thermostat regulating temperature code. ECT reads 175°F after 25 minutes of city driving. The thermostat is replaced. One week later the P0128 returns. ECT again reads 175°F. The cooling fan is confirmed not running continuously. What should the technician check NEXT?

A. The coolant mixture for an incorrect antifreeze-to-water ratio affecting thermostat opening temperature

B. The ECT sensor for an accuracy drift producing a false below-threshold reading

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

D. Whether the replacement thermostat is the correct temperature rating for the vehicle — an incorrect thermostat opens too early, preventing the engine from reaching the PCM's specified regulation temperature

47. A vehicle has LTFT at +16% on both banks at idle that drops to +4% at 2,500 RPM. A standard smoke test finds no vacuum leaks. Fuel pressure is correct. A dynamic MAF test at idle shows the sensor reading within the specification range. What should the technician check NEXT?

A. Perform a low-pressure smoke test — an idle-specific bilateral lean condition with a correct MAF and no standard test leaks may indicate a small leak requiring low-pressure detection

B. Test the upstream O2 sensors for bilateral contamination producing a false lean correction specifically at idle

C. Test the MAF sensor output at idle with a scope — a sensor within specification on average may have a dynamic signal fault not apparent on a static reading

D. Replace the IAC valve — an IAC fault can cause idle-specific lean conditions by allowing excess air past the closed throttle plate

48. A vehicle has a P0300 random misfire and a P0420 catalyst efficiency code set simultaneously. LTFT is +2% on both banks. Compression and leakage are confirmed normal. Ignition waveforms are confirmed normal. What is the MOST likely relationship between the two codes?

A. The P0420 caused the P0300 — a restricted converter raises backpressure, reducing combustion efficiency and causing the random misfire

B. The P0300 random misfire is delivering unburned fuel to the catalytic converter, overheating and damaging the catalyst and setting the P0420

C. Both codes share the same root cause — a lean mixture causing misfires and simultaneously reducing converter efficiency from oxygen surplus

D. The codes are unrelated — the P0420 is from a pre-existing converter fault and the P0300 is from an independent developing fault

49. A vehicle has STFT oscillating between +8% and -8% at approximately 1 cycle per second on both banks simultaneously. LTFT is 0% on both banks. No codes are stored. The engine idle quality is described as slightly rough. What is the MOST likely cause?

A. Both upstream O2 sensors contaminated simultaneously causing erratic bilateral trim oscillation

B. An EVAP purge solenoid that is partially stuck open, allowing intermittent vapor delivery to both banks at idle

C. A MAF sensor with a slightly unstable output signal causing the closed-loop system to hunt around stoichiometry

D. A minor vacuum leak at or near the closed-loop control threshold causing the system to hunt between lean correction and rich overshoot

49. STFT oscillates between +8% and -8% at 1 cycle per second on both banks simultaneously. LTFT is 0% on both banks. Idle is slightly rough. No codes. What is the MOST likely cause?

A. Simultaneous contamination of both upstream O2 sensors

B. A partially stuck-open EVAP purge solenoid delivering intermittent vapor at idle

C. A slightly unstable MAF output causing closed-loop hunting around stoichiometry

D. A minor vacuum leak at the closed-loop control threshold causing hunting between lean correction and rich overshoot

50. A vehicle has all OBD II monitors complete. A P0171 bank 1 lean code and a P0174 bank 2 lean code are both stored. LTFT is +24% on bank 1 and +22% on bank 2. A low-pressure smoke test, a propane enrichment test, and a thorough visual inspection all reveal no vacuum leaks. MAF reads correctly on a dynamic test. Fuel pressure is 58 psi. All injectors pass a balance test. What should the technician check NEXT?

A. The upstream O2 sensors for simultaneous bilateral contamination producing false lean corrections

B. The EVAP purge solenoid for a stuck-closed condition preventing normal vapor delivery and contributing to bilateral positive trims

C. The fuel pump volume output — all pressure and component tests are normal but volume under sustained demand has not been confirmed

D. The exhaust system for bilateral manifold leaks upstream of both O2 sensors simultaneously introducing oxygen and generating false lean corrections

PRACTICE EXAM 20: ANSWER KEY AND EXPLANATIONS

DOMAIN A — GENERAL DIAGNOSIS

1. **C. Restricted exhaust flow preventing the engine from building additional vacuum at elevated RPM** — A steady 16 in/Hg at idle that does not rise at 2,500 RPM under no load is the vacuum gauge pattern of exhaust restriction. A mechanically sound engine with normal timing builds 3–5 in/Hg of additional vacuum when RPM is increased under no load as pumping efficiency improves. When exhaust restriction prevents spent gases from exiting efficiently, the engine cannot improve its pumping efficiency at elevated RPM — vacuum remains flat regardless of speed increase.
2. **A. Worn or damaged piston rings on cylinder 3** — Cylinder 3 reads 80 psi dry and 145 psi wet — a 65 psi improvement after adding oil. A large wet test improvement is the defining confirmation of ring seal failure. Oil pooled on the piston crown temporarily seals the worn ring gap, restoring compression toward normal. A valve fault or head gasket breach would show no meaningful wet test improvement because oil cannot reach or seal those leak paths.
3. **D. Cylinder 4 is contributing minimally — the cause must be confirmed with further testing** — A 20 RPM drop on cylinder 4 against 185–210 RPM on all others confirms cylinder 4 is producing negligible power output. However, a contribution test identifies which cylinder is at fault — it does not identify why. Ignition failure, fuel delivery failure, and compression failure all produce the same minimal contribution result. Further testing of each system on cylinder 4 is required before a root cause can be confirmed.
4. **B. Excessive valve clearance on one or more valves** — A mechanical valve clearance tap is constant at all temperatures and all loads because the clearance gap exists regardless of oil pressure, combustion loading, or thermal state. A hydraulic lifter bleed-down tap disappears within seconds of startup. A camshaft lobe or rocker arm fault typically changes character with load. A steady, light tapping present from cold start through full operating temperature without variation points to a fixed mechanical clearance fault.
5. **A. The intake valve on cylinder 5 is not sealing** — Air escaping from the throttle body inlet during a cylinder 5 leakage test confirms the test air is traveling backward through the intake system. The only path from cylinder 5 to the throttle body air inlet is through the intake valve — air is pushing past a damaged, burned, or improperly seating intake valve, entering the intake manifold, and exiting upstream through the throttle body opening. Exhaust valve leaks exit at the tailpipe; ring leaks exit at the crankcase.

6. **C. Normal engine mechanical condition** — A sharp drop to zero at snap-throttle confirms no restriction to throttle opening. A rebound above baseline to 25 in/Hg on throttle closing confirms strong valve spring tension closing the valves rapidly against a momentarily high vacuum. Return to the original 19 in/Hg confirms stable idle vacuum. All three phases of the snap-throttle response are normal — the test confirms acceptable engine mechanical condition with no valve, timing, or restriction faults.

7. **D. Piston-to-bore clearance excessive when cold, producing a loud slap that decreases with thermal expansion** — A loud knock at cold start that transitions to a lighter tick within 20 seconds is the defining pattern of piston slap from excessive cold clearance. Aluminum pistons expand significantly with heat — a clearance that is excessive when cold closes as the piston reaches operating temperature, reducing the slap to a minor tick or eliminating it. A main bearing knock increases with load and temperature; a timing chain noise does not transition in character within the first 20 seconds.

8. **B. The injector spray pattern for a non-atomizing fault** — Fuel pressure, compression, spark, and injector pulse are all confirmed. Cranking with the throttle to the floor — the clear-flood procedure — makes no difference, suggesting flooding is not the cause. With all fundamental inputs confirmed correct, a fuel delivery quality fault is the remaining explanation. An injector delivering fuel in a solid stream rather than an atomized mist produces a fuel puddle on intake valve surfaces rather than a combustible air-fuel charge — correct pressure and pulse are confirmed but combustible mixture formation fails.

9. **A. The oil for a milky or emulsified appearance** — The pressure test holds perfectly, eliminating any external leak path. A chemical block test is negative, confirming no combustion gas crossover. With external leaks and combustion-side gasket breach both eliminated, the remaining internal coolant loss path is into the oil circuit through a gasket breach between a coolant passage and an oil passage. Coolant entering the oil produces the characteristic milky, emulsified appearance on the dipstick or oil filler cap — detectable without disassembly and confirming the internal breach.

10. **C. The ignition system under load at cruise RPM** — Compression, fuel pressure, and idle ignition waveforms are confirmed normal, and LTFT confirms correct mixture. A misfire exclusively at highway cruise speed and load that is absent at idle and WOT is the pattern of an ignition component that passes low-demand testing but breaks down under the sustained high-voltage demand of cruise operation. A coil with degraded insulation or a plug wire with insulation breakdown passes an idle scope test but arcs internally under the continuous high-voltage requirement of sustained highway cruise firing.

11. **A. Cylinder 5 has no compression** — In a relative compression test, the starter motor works harder — drawing more current — against a cylinder with normal compression. A cylinder with no compression provides no resistance to the piston on the compression stroke — the starter motor encounters no opposing force and draws near-zero amperage during that stroke. Near-zero amperage on cylinder 5's compression stroke is the electrical signature of a complete compression

failure from a severely burned valve, a dropped valve seat, or a catastrophic ring or head gasket failure.

12. **C. Worn or failed valve stem seals on cylinder 8** — All other cylinders show dry plugs, confirming no engine-wide oil consumption path is active. Cylinder 8 shows a wet oily plug with confirmed normal compression and leakage — ruling out ring and head gasket involvement. A localized oily plug on one cylinder with confirmed ring integrity points directly to the valve stem seal as the oil entry path. Oil migrating past a failed stem seal on cylinder 8 coats the plug and insulator without affecting compression or leakage results.

DOMAIN B — IGNITION SYSTEM DIAGNOSIS AND REPAIR

13. **B. Overheating or pre-ignition damage** — A white or light gray blistered insulator with electrode tip erosion and rounded electrode edges confirms the plug has operated far above its designed thermal range. Pre-ignition — abnormal combustion occurring before the spark event — generates extreme heat that blisters the ceramic insulator and rapidly erodes the electrode material. A carbon-fouled plug produces a black sooty deposit, not a white blistered insulator. Normal wear produces light tan coloring with gradual erosion, not blistering.
14. **D. A high-resistance plug wire requiring more voltage to overcome resistance before the plug fires** — An abnormally high firing line on one cylinder indicates the ignition system required excessive voltage to initiate the arc on that cylinder. A high-resistance plug wire forces the coil to build additional voltage to overcome the resistance before the remaining voltage can bridge the electrode gap. The very brief spark line following the high firing line confirms the coil's stored energy was largely consumed overcoming wire resistance, leaving minimal energy for arc sustain.
15. **C. The cylinder 3 coil has failed** — The cylinder 3 coil moved to the cylinder 7 position. P0303 does not return and P0307 sets at the new location. The misfire traveled with the coil from cylinder 3 to cylinder 7, confirming the coil is the fault source. Cylinder 3 fires correctly after the swap with the known-good cylinder 7 coil installed — confirming the cylinder 3 circuit, plug, and compression are all functional with a good coil.
16. **A. A missing or damaged tooth on the camshaft trigger wheel** — A Hall effect sensor switching cleanly between 0 and 5 volts confirms correct sensor circuit operation and element function. One absent pulse per camshaft revolution at the same angular position every revolution confirms the trigger event is missing — not the sensor's ability to detect it. A missing, broken, or severely worn tooth on the trigger wheel at that position produces no magnetic field change as it passes the sensor, generating no switching event and creating the absent pulse consistently at that camshaft position.
17. **C. The spark plug and compression on cylinder 5** — Replacing the shared coil resolved the cylinder 2 misfire but not the cylinder 5 misfire — confirming the shared coil was responsible for the cylinder 2 fault but not the cylinder 5 fault. With a confirmed good coil now serving cylinder 5 and the misfire continuing, the fault is isolated to cylinder 5-specific fixed components. The

spark plug and compression are the most accessible next items to test before pursuing injector or circuit-level diagnosis.

18. **A. A ferrous deposit or chip adhered to one reluctor tooth** — Magnetic reluctance sensor amplitude is determined by the rate of magnetic field change as each tooth passes. A ferrous particle or metallic chip adhered to one tooth surface increases the effective magnetic mass at that position, generating a proportionally stronger field change and higher amplitude signal as that tooth passes. The fault is consistent — the same tooth passes the sensor at the same position every revolution, producing the repeating high-amplitude event at a predictable crankshaft position.

19. **B. A high-resistance condition in the secondary circuit** — Normal post-firing oscillation occurs as the remaining coil energy resonates between the primary and secondary windings after arc extinction. A high-resistance element in the secondary circuit — a resistive plug wire, a corroded coil tower, or a high-resistance plug — absorbs the resonant energy rapidly, dampening the oscillation to one or two cycles before the signal goes flat. Reduced oscillation count is the secondary scope signature of excess resistance in the secondary circuit on that cylinder.

20. **A. The distributor position** — With the timing advance connector unplugged, all electronic advance is disabled and base timing should match the specification exactly. A reading of 22° BTDC against a 10° BTDC specification — 12° of excess advance — with the advance circuit disabled confirms the distributor housing has been physically rotated 12° from its correct position. Distributor rotation is the most common cause of base timing offset and is corrected by loosening the distributor hold-down and rotating the housing to the specified position.

DOMAIN C — FUEL, AIR INDUCTION, AND EXHAUST SYSTEMS

21. **B. A correctly functioning fuel pressure regulator responding normally to manifold vacuum** — Pressure at key-on with no vacuum reference confirms the pump builds adequate pressure. At idle, manifold vacuum applied to the regulator's vacuum port lowers the regulated pressure set point — by design, fuel pressure drops when vacuum is applied so injector differential pressure remains constant as manifold pressure changes. Pressure rising to 55 psi when the vacuum line is removed confirms the regulator is actively and correctly modulating pressure in response to vacuum. This is normal vacuum-referenced regulation, not a fault.

22. **C. The bank 1 exhaust manifold for a leak upstream of the bank 1 O2 sensor** — Bank 1 LTFT at +12% idle dropping to +3% at 2,500 RPM — with confirmed correct injector balance, no smoke test leaks, and bank 2 near-zero LTFT — is the pattern of an exhaust manifold leak upstream of the bank 1 O2 sensor. At idle, low exhaust velocity and high manifold vacuum draw ambient oxygen into the exhaust through the leak, producing a false lean signal. At 2,500 RPM, increased exhaust backpressure reduces oxygen intrusion, normalizing the trim to near-zero.

23. **A. The fuel pressure regulator is functioning correctly** — With the vacuum reference removed and the port plugged, the regulator loses its vacuum-referenced pressure reduction and holds at its base mechanical set point. Pressure rising from the vacuum-referenced idle value to 63 psi —

within the 58–65 psi no-vacuum specification — confirms the regulator's mechanical set point is correctly calibrated and the diaphragm is intact. A ruptured diaphragm would not produce a stable, within-specification reading at the no-vacuum set point.

24. **D. The high-pressure pump volume control valve failing under cold oil viscosity** — Low-pressure supply is confirmed adequate and the cam follower stroke is within specification. Rail pressure at idle after warm-up is normal — confirming the pump builds correct pressure when oil viscosity is normal. During cold start only, the high-pressure pump's volume control valve — which regulates the quantity of fuel compressed per stroke — fails to regulate correctly under the high viscosity of cold oil, delivering insufficient pressure during the brief window before oil warms and viscosity drops to normal operating levels.

25. **D. Normal deceleration fuel cut behavior** — LTFT at +3% throughout all normal driving confirms no lean fault exists during normal operation. During closed-throttle deceleration, the PCM reduces injector pulse width to near zero as a fuel economy measure. With nearly no fuel being delivered, the upstream O2 sensors read lean — often at the minimum 0.1-volt output. The closed-loop system responds to the lean reading by adding positive STFT correction, which may be briefly logged as a LTFT movement. This is a normal calibration behavior, not an indication of a vacuum leak or sensor fault.

26. **B. The wastegate for a stuck-open condition** — The compressor wheel spins freely with no damage — confirming the turbocharger itself is mechanically intact. No charge air leaks are found — confirming boost circuit integrity. A wastegate that is stuck open allows exhaust gas to bypass the turbine continuously, preventing the turbine from spinning fast enough to generate boost pressure regardless of compressor wheel condition. With the turbocharger and charge air circuit confirmed functional, a stuck-open wastegate is the only remaining explanation for severely low boost pressure.

27. **A. Clear fault codes and LTFT adaptive memory, then verify LTFT normalizes after a drive cycle** — The root cause — the cracked intake manifold gasket — has been identified and repaired. The engine idles smoothly, confirming the repair resolved the driveability symptom. The PCM's LTFT adaptive memory still contains the +18% correction learned during the lean condition. Clearing both the fault codes and the LTFT adaptive memory allows the PCM to relearn correct fuel delivery with the leak eliminated. Verifying LTFT returns to within ±5% after a drive cycle confirms the repair is complete.

28. **B. The muffler downstream of the converter is the restriction** — The upstream test at the manifold shows 1.0 psi — confirming no restriction between the manifold and the first test point. The mid-pipe test between the converter and muffler shows 3.8 psi — elevated above the 3.0 psi maximum. With normal pressure confirmed upstream of the converter and elevated pressure confirmed downstream of the converter, the restriction must be between the two downstream test points — within the muffler. The converter has been bracketed as normal on both its upstream and downstream sides.

29. **C. The fuel pump relay for contact resistance causing voltage drop to the new pump** — A new pump module has been installed, eliminating the pump as the fault. Pressure is still below specification at 48 psi — confirming the new pump is not developing full output. A pump that underperforms despite being new is most commonly caused by insufficient supply voltage from high-resistance relay contacts. Voltage drop across corroded or pitted relay contacts reduces the voltage reaching the pump motor, limiting the motor speed and reducing pressure output below what the pump is capable of delivering at full voltage.

30. **B. A fuel volume delivery fault — stable pressure confirms pressure maintenance but high LTFT confirms volume is insufficient** — Stable fuel pressure throughout WOT confirms the pump can maintain pressure against the closed-end rail during the acceleration run. However, LTFT at +18% on both banks at all conditions — including WOT — confirms the fuel control system is adding significant fuel to compensate for a lean condition. A pump that maintains pressure but cannot deliver adequate volume produces exactly this pattern — pressure holds because the pump keeps up with the pressure demand, but the actual fuel mass delivered per unit time is insufficient, producing a persistent lean condition.

DOMAIN D — EMISSIONS CONTROL SYSTEMS

31. **D. The PCV valve for a stuck-closed or internally obstructed condition** — The PCV hose is confirmed unobstructed and manifold vacuum at the intake connection is confirmed at 18 in/Hg — confirming vacuum is available at the inlet side of the PCV valve. No vacuum felt at the finger-blocked valve inlet confirms vacuum is not passing through the PCV valve body despite being present at its outlet port. A PCV valve with a stuck-closed plunger or internal obstruction blocks vacuum from reaching the crankcase side, producing exactly this finding — vacuum confirmed at one end, no passage through the valve.

32. **B. A rich mixture** — Elevated CO and HC are the direct combustion byproducts of a rich air-fuel mixture — excess fuel that cannot fully combust generates both carbon monoxide and unburned hydrocarbons. Low tailpipe O2 confirms the excess fuel is consuming all available oxygen in the combustion process, leaving none to exit at the tailpipe. LTFT at -14% on both banks confirms the PCM is already actively reducing fuel delivery in response to the rich condition — further confirming a genuine rich fault rather than a converter or sensor issue.

33. **D. Replace the EVAP vent solenoid and retest with low-pressure smoke** — The low-pressure smoke test with the vent solenoid commanded closed directly identified a confirmed seep at the vent solenoid body. A seep confirmed by low-pressure smoke testing meets the threshold for EVAP system repair — the P0456 small leak threshold is intentionally sensitive. Applying sealant to a fuel-system component is not an acceptable repair. The vent solenoid body seep confirms the solenoid requires replacement, and retesting with the low-pressure machine confirms the seep is eliminated.

34. **A. The EGR passages are partially carbon-restricted** — The EGR valve actuates on bi-directional test, confirming the motor and circuit are functional. A MAP change of only 3 kPa against an 8–12 kPa specification confirms that even with the valve physically opening, insufficient exhaust gas is reaching the intake manifold to produce the expected pressure change. A valve that moves but delivers subthreshold flow points to a partially carbon-restricted delivery passage — the valve opens but exhaust gas cannot pass through the accumulated carbon deposits at the required volume.

35. **C. The PCM heater control ground has 11.4 volts of voltage drop** — Heater supply voltage is 12.6 volts and heater element resistance is within specification. The PCM heater control ground should measure near zero volts — a functional ground driver pulls the circuit close to battery negative. A reading of 11.4 volts on the ground circuit referenced to battery negative means 11.4 volts is being dropped across the ground path resistance before reaching the battery. This extreme voltage drop confirms high resistance in the PCM heater ground circuit — insufficient current flows through the heater element, generating the P0135 heater circuit fault.

36. **A. Both upstream O2 sensor heaters activated and brought the sensors to operating temperature** — Both sensors showed a strong lean response for the first 15 seconds, confirming the AIR pump delivered adequate airflow to both banks during that period. The transition to rich voltage while the pump continues running confirms the sensors are now detecting actual exhaust composition rather than the air-injection-induced lean condition. Once the O2 sensor heaters bring the sensing elements to operating temperature — typically 600°F — the sensors begin accurately reporting the normal rich cold-start combustion chemistry, producing the rich voltage transition independent of AIR pump operation.

37. **D. The downstream switching rate of 0.9 against the upstream rate of 1.0 confirms near-zero converter efficiency — P0430 is valid** — A downstream switching ratio of 0.9 cycles per second against an upstream rate of 1.0 cycles per second represents a difference of only 0.1 cycles per second — the downstream sensor is switching at 90% of the upstream rate. A converter with meaningful oxygen storage capacity causes the downstream sensor to switch several times slower than the upstream. A near-identical switching rate confirms the converter has essentially no remaining buffering capacity — exhaust composition passes through unchanged — validating the P0430 regardless of backpressure or LTFT values.

DOMAIN E — COMPUTERIZED ENGINE CONTROLS INCLUDING OBD II

38. **B. Normal fuel control operation — trims within ±10% on both banks require no action** — STFT at -1% and LTFT at -2% on both banks at all conditions are well within the accepted ±10% normal operating range. Bilateral symmetry and consistency at all speeds with complete monitors and no stored codes confirm normal closed-loop fuel control. Minor bilateral negative corrections within normal limits are expected and require no diagnostic action.

39. **D. The purge solenoid is functioning correctly — vapor delivery drops LTFT and solenoid closing restores baseline** — Base LTFT at +2–3% on both banks confirms a slight lean baseline within normal range. The bilateral LTFT drop to -5% during commanded purge followed by return to baseline when purge is commanded off confirms the solenoid opens when commanded, delivers canister vapor to both banks simultaneously, and closes correctly when commanded off. The controlled, reversible LTFT response to a commanded on/off cycle is the confirmation of normal purge solenoid operation.

40. **D. The EVAP purge solenoid for preferential vapor delivery to bank 1** — All bank 1 delivery components — injectors, pressure, MAF — are confirmed correct. The bank 1 O2 sensor switches normally between 0.1 and 0.9 volts, confirming it is accurately reflecting a genuine rich condition on bank 1. With fuel delivery confirmed correct and the sensor confirmed accurately reporting, the unidentified excess fuel source on bank 1 must originate outside the normal injection system. An EVAP purge solenoid or manifold routing that delivers disproportionate canister vapor to the bank 1 intake introduces unmetered fuel, creating the unilateral rich correction without a corresponding injector or pressure fault.

41. **A. The IAT signal circuit has an open** — A P0113 high voltage code with -38°F IAT reading in a 70°F shop confirms the PCM is interpreting a near-reference voltage as maximum sensor resistance — the cold extreme of the IAT calibration. A DVOM reading of 4.95 volts on the signal wire with the sensor connected confirms the signal wire is at near-reference voltage. A functional IAT sensor pulls the signal wire below 5 volts — toward ground — through its internal resistance. A circuit reading 4.95 volts with the sensor connected confirms the sensor's ground path or the sensor itself is open, leaving the signal wire at the reference voltage with no pull-down.

42. **B. The bank 1 upstream O2 sensor developing a rich bias at thermal equilibrium** — The lean-to-rich LTFT progression building over 45 minutes of highway driving — from +2% to -15% — correlates precisely with the O2 sensor reaching and stabilizing at its maximum thermal operating temperature during sustained highway operation. An O2 sensor with a developing element fault that manifests as a rich output bias at high sustained temperatures causes the PCM to progressively remove fuel over the warm-up period. Bank 2 remaining stable confirms no shared system fault — the progressive, temperature-correlated bank 1 rich correction isolates the bank 1 upstream sensor element.

43. **B. The IAC passage in the throttle body is carbon-restricted** — An IAC command of 85% confirms the PCM is demanding near-maximum idle airflow. The throttle plate closing fully eliminates throttle plate position as the cause. No vacuum leaks eliminate unmetered air as the explanation for low idle. With the PCM commanding maximum airflow through the IAC but idle still below specification, the IAC valve is opening correctly but the passage it controls is restricted. Carbon buildup in the throttle body IAC bypass bore limits physical airflow despite correct valve command, preventing the engine from receiving enough air to sustain the specified idle RPM.

44. **D. The signal wire has a short to the 5-volt reference** — Reference voltage is 5.0 volts and ground resistance is 0.1 ohms — both confirmed correct. The signal wire reading 5.0 volts at rest with the sensor connected and no switching during cranking confirms the signal wire is being held at the reference voltage by an external fault rather than by sensor output. A functional Hall effect sensor output pulls the signal wire toward ground during cranking as teeth pass. A signal wire shorted to the 5-volt reference holds the output at 5 volts regardless of sensor switching activity, producing 5.0 volts at rest and no switching during cranking.

45. **A. Perform a fuel injector flow test and review Mode 6 data** — All monitors are complete with no codes and normal fuel trims — confirming no fault has crossed the code-setting threshold. A 20% fuel economy reduction over 2 months without drivability symptoms or codes suggests a subtle over-delivery fault developing within the PCM's trim compensation range. Mode 6 data may show injector-related parameters approaching fault thresholds, and an injector flow test may reveal excess delivery that the O2 sensors and LTFT are masking. These non-invasive tests identify the developing fault before committing to mechanical testing.

46. **D. Whether the replacement thermostat is the correct temperature rating** — The thermostat was replaced one week ago and the P0128 returned — making a second identical thermostat failure unlikely. The cooling fan is confirmed not running continuously, eliminating the most common cause of P0128 recurrence after replacement. An incorrectly rated thermostat — one calibrated to open at a lower temperature than the OEM specification — opens prematurely and allows coolant to circulate through the radiator before the engine reaches the PCM's target regulation temperature, producing a persistent P0128 with an ECT that stabilizes below threshold regardless of driving duration.

47. **A. Perform a low-pressure smoke test** — LTFT at +16% bilaterally at idle dropping to +4% at 2,500 RPM is the classic pattern of an idle-specific vacuum leak. A standard smoke test found no leaks and MAF reads correctly — but small leaks below the standard smoke machine's detection threshold can produce significant idle-specific bilateral lean corrections. A low-pressure smoke machine generates smaller particles at lower pressure, capable of detecting pinhole leaks and seeps that standard testing misses. Performing the low-pressure test is the logical next step before pursuing sensor replacement or more complex diagnosis.

48. **A. The P0420 caused the P0300 — a restricted converter raises backpressure, reducing combustion efficiency** — Normal compression, leakage, fuel trims, and ignition waveforms confirm no independent misfire cause exists in the delivery or ignition systems. A catalytic converter restricted enough to generate a P0420 efficiency code also creates elevated exhaust backpressure that reduces the engine's ability to scavenge exhaust gases from the cylinders. Elevated backpressure increases residual exhaust gas dilution of the incoming charge, reducing combustion efficiency and triggering a random misfire below the cylinder-specific threshold — the two codes share a single root cause.

49. **B. An EVAP purge solenoid that is partially stuck open, allowing intermittent vapor delivery** — STFT oscillating at approximately 1 cycle per second with near-zero LTFT and slightly rough idle describes a periodic mixture disturbance with a balanced long-term average. A purge solenoid that is partially stuck open delivers intermittent bursts of fuel vapor into the intake at irregular intervals — the closed-loop system alternately adds fuel correction when vapor stops and removes it when vapor resumes, creating the observed oscillation. Unlike a vacuum leak — which causes constant lean LTFT — a vapor delivery fault keeps LTFT near zero while producing periodic STFT swings.

50. **C. The fuel pump volume output — all pressure and component tests are normal but volume under sustained demand has not been confirmed** — Low-pressure smoke, propane enrichment, visual inspection, MAF dynamic testing, fuel pressure, and injector balance are all confirmed normal — eliminating vacuum leaks, MAF faults, and delivery component faults. LTFT at +24% and +22% bilaterally confirms a severe, global lean condition with no identified cause. Fuel pressure confirms the pump maintains pressure at low-to-moderate demand but does not confirm adequate volume delivery under sustained high-demand conditions. A pump with a worn impeller maintains static pressure but cannot deliver sufficient fuel volume at sustained cruise and higher loads, producing the global bilateral lean condition with no other identifiable cause.