

PRACTICE EXAM 16: ASE A1 ENGINE REPAIR SIMULATION (50 QUESTIONS)

1. A technician is diagnosing an inline-4 engine that has a single-cylinder misfire at idle (P0302) that completely disappears above 1,500 RPM. The spark plug, coil, and injector have all been swapped with cylinder 1 — the misfire stays on cylinder 2. A compression test shows cylinder 2 at 138 PSI while all others are between 152 and 162 PSI. The specification minimum is 140 PSI. A wet test raises cylinder 2 to 142 PSI. A leak-down test shows 14% leakage with faint air at both the oil filler cap and the tailpipe. Which of the following BEST explains why the misfire disappears above 1,500 RPM despite the mechanical deficiencies?

- A. The PCM applies additional fuel enrichment above 1,500 RPM that masks the weak cylinder's misfire
- B. The exhaust valve on cylinder 2 seats more firmly at higher RPM due to increased valve spring inertia forces
- C. The leak-down results indicate a head gasket failure rather than ring or valve wear, and gasket leaks seal at higher RPM
- D. At higher RPM, increased cylinder charge volume and pressure overcome the combined minor ring and valve leakage to sustain combustion

2. A customer reports that after replacing the serpentine belt, the engine developed a noticeable vibration at idle that was not present before the belt change. The vibration is felt through the steering wheel and seats. The engine runs smoothly on all cylinders with no misfires. The new belt is the correct part number and the tensioner was replaced simultaneously. Which of the following is the MOST likely cause?

- A. The new serpentine belt is slightly longer or shorter than specification, causing the automatic tensioner to operate at an incorrect position that introduces a vibration
- B. The replacement belt has a manufacturing defect with uneven rib heights that create harmonic vibration
- C. The new belt tensioner has a defective dampening mechanism that allows the tensioner arm to oscillate
- D. The belt routing was incorrect and the belt is running on the wrong side of one of the idler pulleys

3. A V8 engine produces a faint but steady hissing sound from the right cylinder head area that is present at idle and increases with RPM. The sound is most audible near the number 7 exhaust port. A careful visual inspection with the engine running shows no visible exhaust gas escape at the manifold gasket surface. A propane enrichment test around the area does not change idle quality or RPM. Which of the following is the MOST likely source of the hissing?

A. A hairline crack in the exhaust manifold runner at the number 7 position that is too small to see visually

B. An internal exhaust valve stem seal leak on cylinder 7 that produces a hissing as oil vaporizes on the valve

C. A crack in the cylinder head between the number 7 exhaust port and a coolant passage that produces a hissing as coolant vaporizes on the hot exhaust port wall

D. A loose spark plug on cylinder 7 that allows exhaust to hiss past the plug threads under combustion pressure

4. A technician is rebuilding an engine and discovers that the number 5 connecting rod big-end bore is 0.001 inches out-of-round when the cap is torqued to specification. All other rods measure within 0.0003 inches of round. The rod bolts are the correct application and are being torqued to specification. Which of the following is the MOST likely cause?

A. The number 5 rod cap was installed reversed (180 degrees from its correct orientation) during this measurement

B. The number 5 connecting rod has fretting damage at the cap-to-rod mating surface from the previous engine's operation

C. The rod bolt torque specification is incorrect for the number 5 position due to its longer bolt shank length

D. The number 5 rod bore was manufactured out of specification from the factory and was never detected

5. A customer reports that the engine oil consumption has increased dramatically — from near zero to one quart every 400 miles — within a two-week period. The engine has 65,000 miles. There is no visible exhaust smoke at any condition. Compression is within specification on all cylinders. Oil pressure is normal. The PCV valve was replaced one week before the consumption increase began. Which of the following should the technician investigate FIRST?

- A. The valve stem seals for sudden simultaneous failure across all cylinders from a batch defect
- B. The cylinder bore crosshatch for loss of the hone pattern that could cause sudden ring seal failure
- C. The turbocharger seals for a sudden failure that allows oil into the intake tract under boost conditions
- D. Whether the replacement PCV valve is the correct application — an incorrect valve can dramatically alter crankcase ventilation flow and pull excessive oil into the intake

6. Technician A says that a cylinder head with a crack between a combustion chamber and a coolant passage can sometimes run for thousands of miles before symptoms become severe enough for the customer to notice. Technician B says that a crack between two adjacent exhaust valve seats can grow rapidly because the extreme thermal cycling in the exhaust area accelerates crack propagation. Who is correct?

- A. Both Technician A and Technician B
- B. Technician A only
- C. Technician B only
- D. Neither Technician A nor Technician B

7. A rebuilt engine has been running for 5,000 miles with no issues. The customer returns complaining that the oil pressure at hot idle has dropped from 28 PSI at the 500-mile check to 20 PSI now. The specification minimum is 15 PSI. Oil level and viscosity are correct. At 2,500 RPM, pressure reads 48 PSI (specification 40 to 65). No knocking or abnormal noise is present. Which of the following is the MOST accurate assessment?

- A. The oil pump is wearing prematurely and should be replaced before the pressure drops below specification
- B. The 8 PSI drop from 28 to 20 PSI over 5,000 miles is within the expected range of normal post-break-in bearing wear-in and all readings remain within specification
- C. The main bearings were assembled with clearances at the loose end of specification and are now approaching failure
- D. The oil pressure relief valve spring has weakened from heat cycling and is allowing early pressure bypass

8. A technician is diagnosing a vehicle with a P0420 code (catalyst efficiency below threshold, bank 1). The engine has no misfires, no oil consumption, and no performance complaints. The upstream O2 sensor switches normally. The downstream O2 sensor shows a lazy switching pattern that nearly mirrors the upstream sensor. The catalytic converter was replaced 8,000 miles ago. Which of the following should the technician investigate FIRST before condemning the converter again?

- A. The upstream O2 sensor for contamination that may be providing incorrect readings to the fuel control system
- B. The downstream O2 sensor for a heater circuit failure that is preventing the sensor from reaching operating temperature
- C. Whether the replacement converter was an aftermarket unit that may not meet the emissions efficiency required for this application
- D. The exhaust system for leaks between the converter and the downstream sensor that could introduce ambient oxygen

9. A four-cylinder engine exhibits a condition where the oil pressure gauge shows 45 PSI at cold startup, drops to 22 PSI as the engine warms to operating temperature, and reads 50 PSI at 2,500 RPM hot. The specification is 20 PSI minimum at hot idle and 40 to 65 PSI at speed. The customer is concerned about the 23 PSI drop from cold to hot idle. Which of the following is the correct explanation?

- A. The bearings are wearing unevenly and the pressure will continue to drop as the wear progresses
- B. The oil pump is producing less output at higher temperatures due to thermal expansion of the pump gears
- C. The oil filter bypass valve opens when the oil thins at operating temperature, reducing effective system pressure
- D. The cold-to-hot pressure drop is entirely normal and results from the oil's viscosity decreasing as it reaches operating temperature — thinner oil flows more easily through bearing clearances, reducing measured pressure

10. A technician removes a cylinder head from a V6 engine for a head gasket replacement. After the head is removed, the technician notices that the number 4 piston crown is significantly cleaner than the other pistons — it appears steam-cleaned with almost no carbon deposits. All other piston crowns show the normal carbon accumulation. Which of the following does this observation indicate about cylinder 4?

- A. Coolant has been entering the number 4 combustion chamber through the head gasket breach and steam-cleaning the piston during operation
- B. The fuel injector on cylinder 4 has been over-delivering fuel that washed the carbon off the piston crown
- C. The spark plug on cylinder 4 has been misfiring for an extended period, preventing carbon from forming
- D. Cylinder 4 has had excessive blowby that prevented carbon deposits from adhering to the piston crown

11. A technician is performing a valve job and needs to check the valve seat concentricity to the guide bore. The technician uses a dial indicator with a pilot that fits into the guide bore and reads the seat runout as the indicator is rotated 360 degrees. The indicator reads 0.003 inches of total indicator runout (TIR). The specification maximum is 0.002 inches. Which of the following is the correct action?

- A. Lap the valve to the seat to improve concentricity because lapping distributes the contact more evenly
- B. Replace the valve guide because the guide is likely worn and causing the seat to read eccentric
- C. Recut the valve seat using a properly centered pilot to bring the concentricity within the 0.002-inch specification
- D. The 0.003-inch reading is close enough to specification and the valve will seal adequately with normal spring pressure

12. A customer's engine has had an intermittent oil pressure warning light that flickers at hot idle for the past month. Oil level is correct. The oil was changed 500 miles ago with the correct specification oil and filter. The technician connects a mechanical gauge and reads 9 PSI at hot idle. The specification minimum is 10 PSI. At 1,500 RPM, the pressure rises to 30 PSI. Which of the following is the MOST appropriate FIRST action?

- A. Replace the oil pump because the idle pressure is below the minimum specification
- B. Switch to a heavier-viscosity oil to raise the idle pressure above the 10 PSI threshold
- C. Replace the engine because below-spec idle pressure indicates imminent bearing failure
- D. Verify the oil filter is the correct application and that the drain plug is properly sealed, then investigate the cause of the marginal pressure

13. A V6 engine with 190,000 miles produces a rhythmic thumping from the lower engine at idle that becomes louder under load. The thump does not change when individual cylinders are disabled. Oil pressure is 8 PSI at hot idle — below the 12 PSI minimum. A slight but visible oil weep is present at the rear main seal area. The oil appears normal and the coolant is clean. Which of the following MOST accurately describes the combined diagnostic significance of all these findings?

- A. The rear main seal leak is the primary issue and the low oil pressure is caused by oil volume loss through the seal
- B. The worn main bearings are producing the thump, causing the low oil pressure from excessive clearance, and the increased crankcase pressure from worn bearings is forcing oil past the rear main seal
- C. The oil pump has failed and the lack of pressure is causing both the noise and the seal leak simultaneously
- D. The crankshaft thrust bearing has failed, producing the thump from axial movement and the seal leak from the shaft shifting rearward

14. A technician discovers that a rebuilt engine has been assembled with the number 1 and number 4 connecting rods swapped — they are in each other's positions. Both rods are the same part number and specification. The engine has not been started. Which of the following describes the significance of this swap?

- A. On most engines with identical rods of the same specification, the swap has no effect and the engine can be started as assembled
- B. The swap will cause both pistons to contact the valves because the rod offsets are reversed
- C. The swap will cause oil starvation to both cylinders because the oil squirt holes now face the wrong direction
- D. The swap will produce a crankshaft imbalance because each rod position has a unique weight-matching requirement

15. A customer reports that the engine has been gradually losing coolant over the past three months — approximately one pint per month. There are no visible external leaks, no white smoke, no oil contamination, and the block test is negative at idle and at 2,500 RPM. The heater works normally. The overflow tank level drops but the radiator stays full. Which of the following BEST explains this pattern?

- A. A very small head gasket breach that is below the detection threshold of both the block test and visible symptoms
- B. The overflow tank has a hairline crack below the coolant level that weeps when the system pushes coolant into the tank during driving and the weep evaporates on the hot tank surface
- C. The radiator cap vacuum valve is stuck closed, preventing coolant from being drawn back from the overflow tank after each heat cycle, so the overflow tank gradually empties while the radiator stays full
- D. The radiator cap vacuum valve is stuck closed — during each heat cycle, coolant is pushed to the overflow tank but cannot be drawn back when the engine cools, so the overflow gradually empties while the radiator remains full

16. Technician A says that on a four-stroke engine, the intake valve opens before TDC on the exhaust stroke to take advantage of the outgoing exhaust gas's momentum to begin drawing in the fresh charge. Technician B says that the exhaust valve closes after TDC on the intake stroke to allow the last remaining exhaust gas to be scavenged by the incoming intake charge. Who is correct?

- A. Technician A only
- B. Technician B only
- C. Both Technician A and Technician B
- D. Neither Technician A nor Technician B

17. A rebuilt engine develops a clicking noise from the right cylinder head area within the first 100 miles. The clicking tracks with engine RPM and is isolated to the number 3 exhaust rocker arm using a stethoscope. The technician removes the valve cover and observes the rocker arms — number 3 exhaust has visible lash (free play) at the valve stem tip while the engine is running, while all other rocker arms show no visible lash. This is an OHV engine with hydraulic lifters and non-adjustable rocker arms. Which of the following is the MOST likely cause?

- A. The replacement hydraulic lifter at the number 3 exhaust position is defective and cannot pump up to zero lash
- B. The exhaust pushrod for cylinder 3 is too long and is holding the lifter plunger at the bottom of its travel
- C. The rocker arm at number 3 exhaust has an incorrect pivot height that changes the geometry and creates lash

D. The camshaft lobe for number 3 exhaust was installed with insufficient break-in lubrication and has already worn flat

18. A technician performs a cooling system pressure test on a vehicle with an intermittent overheating complaint. The system holds pressure perfectly at 16 PSI for 30 minutes with the engine cold. The technician then starts the engine and lets it reach operating temperature. Within 5 minutes of reaching operating temperature, the pressure gauge reads 22 PSI — well above the 16 PSI cap rating — and continues to climb. Which of the following is the MOST likely cause?

A. The radiator cap pressure relief valve is stuck closed and not venting at its rated 16 PSI setting

B. Combustion gas is entering the cooling system through a head gasket breach, pressurizing the system beyond the cap's ability to vent

C. The water pump is generating excessive pressure at the operating RPM of the warm engine

D. The coolant temperature has exceeded its boiling point and the steam pressure is overriding the cap

19. A technician discovers during an engine rebuild that the block deck surface has a 0.003-inch depression — a low spot approximately 1 inch in diameter — near the number 3 cylinder bore. The rest of the deck surface is flat within 0.001 inches. The low spot is not a scratch or gouge — it is a smooth, localized area that is simply lower than the surrounding surface. Which of the following is the MOST likely cause?

A. A previous repair used a localized heating method that warped the deck surface in that area

B. The low spot is an erosion pattern from coolant that leaked past the head gasket and etched the block surface over time

C. The area experienced localized overheating that softened the metal and allowed the head bolt clamping force to depress it

D. A casting porosity defect in the block that was filled at the factory and has now recessed below the surrounding surface

20. A customer brings in a vehicle reporting that the engine runs normally except for a brief stumble that occurs exactly once during each cold start — approximately 5 seconds after the engine fires. The stumble lasts less than one second and does not recur. No codes are stored. All engine mechanical tests are normal. Fuel pressure and ignition are normal. The condition is repeatable on every cold start. Which of the following is the MOST likely cause?

- A. The engine transitions from open-loop cold-start enrichment to closed-loop fuel control and the brief lean/rich correction produces a momentary stumble
- B. The PCM momentarily activates the EVAP purge valve during the cold-start sequence and the vapor causes a stumble
- C. The A/C compressor clutch briefly engages during the cold-start self-test and loads the engine momentarily
- D. The idle air control system overshoots its initial fast-idle setting and then corrects, causing a momentary RPM dip

21. A technician is diagnosing a V8 engine where bank 2 (cylinders 5 through 8) consistently runs approximately 15°F hotter than bank 1 according to exhaust gas temperature sensors at the manifold. The engine has dual exhaust with separate catalytic converters. Both banks have the same fuel trim values. Compression is equal across all cylinders. Which of the following is the MOST likely cause?

- A. The bank 2 exhaust manifold has a partially restricted runner that increases back-pressure and heat on that bank
- B. The bank 2 catalytic converter is failing and creating back-pressure that raises exhaust gas temperature
- C. A coolant flow imbalance in the engine that provides less cooling to bank 2's cylinders than bank 1
- D. The bank 2 exhaust manifold gasket has a small leak that introduces air and causes higher combustion temperatures

22. A four-cylinder engine with a timing chain produces the following compression results: Cyl 1 = 125, Cyl 2 = 128, Cyl 3 = 122, Cyl 4 = 126. The specification is 145 to 160 PSI. All readings are uniformly low. A timing light shows the base timing is 12 degrees retarded from the specified position. The chain has not been replaced in 180,000 miles. A wet test improves all cylinders by only 5 to 8 PSI. Which of the following BEST explains the relationship between these findings?

- A. The uniformly low compression is caused entirely by ring wear, and the retarded timing is a coincidental separate issue
- B. The ring wear confirmed by the wet test improvement is the sole cause of the low compression, and the timing chain stretch only affects timing, not compression

C. The timing chain stretch has retarded the cam timing, causing the valves to close late and reducing the effective compression on all cylinders — the minimal wet test improvement confirms that rings are not the primary cause

D. The retarded timing is caused by a faulty crankshaft position sensor rather than chain stretch, and the compression loss is from valve wear

23. A customer reports that the engine produces a loud popping noise from the intake manifold area during cranking that occurs once every few seconds while the starter is engaged. The engine eventually starts after 10 to 15 seconds of cranking. Once running, the engine operates normally with no misfires or unusual sounds. This condition occurs on every start — both cold and warm. Which of the following is the MOST likely cause?

A. A fuel injector that sticks open and floods one cylinder, causing a backfire through the intake during cranking

B. A weak ignition coil that intermittently fails to produce spark during the lower voltage of cranking speed

C. A restricted exhaust that creates sufficient back-pressure during cranking to push combustion gas back through the intake

D. One or more intake valves that are slightly open during what should be the compression stroke due to incorrect valve timing, allowing compression to push back through the intake

24. Technician A says that on a rebuilt engine, the first oil change should be performed at 500 miles to remove the initial break-in contaminants — assembly lubricant residue, microscopic metal particles from ring seating, and honing grit that escaped the cleaning process. Technician B says that a magnetic drain plug should be used on a rebuilt engine to capture ferrous metal particles that pass through the oil filter. Who is correct?

A. Both Technician A and Technician B

B. Technician A only

C. Technician B only

D. Neither Technician A nor Technician B

25. A vehicle's engine has been diagnosed with a cracked cylinder head. The crack runs from the combustion chamber of cylinder 3 to the oil drain-back passage at the rear of the head. The engine oil

has been gradually turning dark gray. There is no coolant contamination in the oil and no white smoke from the exhaust. Which of the following BEST explains the gray oil discoloration?

- A. Combustion gases are leaking through the crack into the oil drain-back passage and mixing with the engine oil
- B. Combustion gas is being forced through the crack into the oil drain-back passage, and the carbon and soot in the gas is contaminating and darkening the oil beyond its normal rate
- C. The crack is allowing oil to leak into the combustion chamber of cylinder 3, which has no effect on oil color
- D. The crack is allowing ambient air into the drain-back passage, which is oxidizing the oil prematurely

26. A rebuilt engine develops an oil leak at the front crankshaft seal after 2,000 miles. The seal was new and properly installed. The PCV system is functional and crankcase pressure is within specification. The technician removes the harmonic balancer and inspects the seal contact area on the crankshaft snout. The surface is smooth with no groove or wear mark. However, the technician notices that the seal lip has a clear wear line that is off-center — the line is not concentric with the crankshaft centerline. Which of the following is the MOST likely cause?

- A. The seal was pressed to an incorrect depth in the timing cover during installation
- B. The crankshaft snout has developed a slight bend from a previous balancer installation impact
- C. The timing cover is misaligned from the block, causing the seal bore to be offset from the crankshaft center
- D. The harmonic balancer is running eccentric on the crankshaft snout, causing the seal lip to wear unevenly and eventually fail

27. A technician is diagnosing a six-cylinder engine that has a slight but persistent rough idle with no stored codes. All six spark plugs show a normal tan color. Compression is within specification on all cylinders. Fuel trims are within plus or minus 5% on both banks. A vacuum gauge shows a steady 18 in. Hg — within normal range. The ignition timing is correct. The technician performs a relative compression test using a starter current clamp and oscilloscope. Five cylinders show nearly identical current spike amplitudes. Cylinder 4 shows a spike approximately 15% lower than the others. Which of the following does this finding indicate?

- A. Cylinder 4 has an injector that is over-delivering fuel, which shows up as a lower current draw during cranking
- B. Cylinder 4 has slightly lower compression than the other cylinders — enough to cause a marginal idle roughness but not enough to fail a standard compression test or set a code
- C. Cylinder 4's relative compression result indicates a slightly lower compression than the others, despite the standard test being within specification, because the relative test is more sensitive to small differences between cylinders
- D. The current clamp is positioned incorrectly and is reading cylinder 4 at a different sensitivity than the others

28. A customer states that the engine has been making a single loud "clunk" every time the vehicle comes to a complete stop. The noise comes from the front of the engine area. It does not occur during driving, during acceleration, or when the vehicle is parked and the engine is idling. The transmission is an automatic. Which of the following is the MOST likely cause?

- A. A broken engine mount that allows the engine to shift forward from the deceleration force when the vehicle stops, then settles back against the mount stop
- B. A loose crankshaft harmonic balancer that shifts position when the rotational deceleration stops the crankshaft
- C. Excessive crankshaft end play that allows the crankshaft to shift axially when the torque converter load changes at full stop
- D. A worn timing chain that has enough slack to slap forward when the crankshaft decelerates to idle from vehicle stopping

29. A technician is evaluating an engine for a customer considering purchasing a used vehicle. The engine has unknown service history and 155,000 miles. A compression test shows all six cylinders between 138 and 145 PSI. The specification is 145 to 170 PSI. Three of six cylinders are at or above the minimum specification and three are marginally below. Oil pressure is 18 PSI at hot idle (specification minimum 15 PSI) and 42 PSI at 2,500 RPM (specification 40 to 65 PSI). No knocking or unusual noise is detected. Which of the following is the MOST accurate assessment to provide the customer?

- A. The engine is in excellent condition and needs no further evaluation for the purchase decision
- B. The engine shows moderate wear consistent with its mileage — three cylinders are marginally below the compression specification and oil pressure is in the lower portion of the acceptable range, suggesting the engine has significant but not critical wear

C. The engine needs immediate rebuilding because three cylinders are below the compression specification

D. The compression readings indicate a timing chain problem because all cylinders are uniformly affected

30. A rebuilt engine is being started for the first time. The technician pre-primed the oil system and observed 45 PSI on the gauge during priming. The engine starts and the pressure gauge shows 55 PSI at 1,500 RPM on the fast idle cam. After 30 seconds, the technician checks the exhaust from each cylinder by holding a hand near each manifold port. Three of the four ports pulse strongly with hot exhaust. The number 2 port pulses weakly compared to the others and the exhaust from that port feels cooler. Which of the following should the technician do FIRST?

A. Shut the engine down and recheck the number 2 spark plug connection, fuel injector connector, and compression to identify why that cylinder is not contributing equally

B. Continue running the engine because uneven exhaust pulses are normal during the first few minutes of a rebuilt engine's break-in period

C. Immediately disassemble the engine because the weak number 2 port indicates a bent valve from a timing error

D. Rev the engine to 3,000 RPM to see if the weak port corrects itself under increased airflow conditions

31. A vehicle with a DOHC turbocharged engine develops a check engine light with code P0016 (camshaft/crankshaft position correlation) and a P0011 (intake camshaft position over-advanced). The engine has 45,000 miles with regular oil changes using the manufacturer-specified oil. The engine runs rough at idle and has reduced low-speed torque. Which of the following is the MOST likely cause at this mileage?

A. A timing chain that has stretched prematurely from a manufacturing defect or a chain design weakness

B. A VVT oil control valve failure from contamination or an internal electrical fault

C. A camshaft position sensor that has failed and is sending incorrect data to the PCM

D. Both codes together at 45,000 miles with proper maintenance most likely indicate a VVT oil control valve fault or cam phaser internal failure rather than chain stretch

32. An engine exhibits a condition where the oil pressure gauge needle vibrates rapidly (oscillates) at idle — bouncing between 18 and 22 PSI several times per second. At 2,000 RPM, the needle steadies at 45 PSI with no oscillation. The engine sounds normal at both idle and cruise. Which of the following is the MOST likely cause of the oscillating gauge reading at idle?

- A. Normal oil pressure pulsation at idle from the intermittent pump gear engagement that smooths out at higher RPM when the pulsation frequency exceeds the gauge's response time
- B. Air in the oil system from a pickup tube O-ring leak that causes the pump to cavitate at idle but is overwhelmed at higher RPM
- C. A worn oil pump with excessive gear-to-housing clearance that causes pulsating output at low speed
- D. The oil pressure sending unit has a faulty internal element that oscillates at low pressure readings

33. A customer brings in a vehicle with a turbocharged engine complaining that the engine hesitates under boost and the check engine light is on with a P0299 (underboost) code. Maximum boost reaches only 10 PSI instead of the specified 18 PSI. The wastegate actuator rod moves freely. The intercooler piping has been checked for leaks with a smoke test and no leaks were found. The air filter is clean. Which of the following should the technician check NEXT?

- A. The catalytic converter for restriction that would limit exhaust flow to the turbocharger's turbine
- B. The turbine housing for cracks that would divert exhaust around the turbine wheel
- C. The wastegate valve itself for carbon buildup that may be holding it partially open despite the actuator rod moving freely
- D. The turbocharger compressor wheel for damage that would reduce its ability to pressurize the charge air

34. A technician is performing a cylinder leak-down test and discovers that cylinder 5 on a V8 engine has 30% leakage with air heard at the tailpipe only — no air at the oil filler, intake, or coolant. The compression on cylinder 5 is 128 PSI — below the 140 PSI minimum. A wet test shows only 3 PSI improvement. Which of the following is the definitive diagnosis based on these combined findings?

- A. Cylinder 5 has worn piston rings because the leak-down air was heard at the tailpipe
- B. Cylinder 5 has an exhaust valve that is not sealing — confirmed by the tailpipe air path, the below-spec compression, and the minimal wet test improvement

- C. Cylinder 5 has a head gasket breach to an exhaust port that the leak-down test is detecting
- D. The leak-down tester is overpressurizing the cylinder and forcing air past a normal exhaust valve seat

35. A rebuilt engine has been running for 10,000 miles with excellent performance. The customer brings the vehicle in for a routine oil change and mentions that the engine seems to be running slightly hotter than before — the gauge sits about one needle-width above the midpoint. The coolant level is correct. The fan operates. The system holds pressure. A block test is negative. The technician measures the coolant concentration and finds it is 65% antifreeze and 35% water instead of the recommended 50/50 mix. Which of the following BEST explains the slightly elevated temperature?

- A. The 65% antifreeze concentration raises the boiling point too high, preventing adequate heat transfer at the surface
- B. A 65/35 mixture has the same thermal characteristics as a 50/50 mixture and the temperature change has another cause
- C. The 65% concentration is increasing system pressure beyond the cap's rating, which raises the operating temperature
- D. Antifreeze has lower thermal conductivity and specific heat than water — a mixture with more antifreeze transfers heat less efficiently, causing the engine to run slightly warmer

36. Technician A says that when installing a camshaft in an OHV engine, the cam lobes should be coated with a moly-based break-in lubricant to prevent lobe and lifter scuffing during the critical first minutes of operation. Technician B says that a new flat-tappet camshaft must be broken in by running the engine at 2,000 to 2,500 RPM for the first 20 minutes to ensure adequate oil splash reaches all lobe surfaces. Who is correct?

- A. Both Technician A and Technician B
- B. Technician A only
- C. Technician B only
- D. Neither Technician A nor Technician B

37. A technician is measuring the crankshaft end play on a rebuilt engine. With the crankshaft pushed fully rearward, the dial indicator is zeroed. When the crankshaft is pried forward using a screwdriver between the counterweight and the block, the indicator reads 0.012 inches. The specification is 0.002 to 0.010 inches. Which of the following is the MOST likely cause of the excessive end play?

- A. The thrust bearing was installed in the wrong main bearing position during assembly
- B. The thrust bearing has insufficient flange width or incorrect thickness for the crankshaft's thrust journal dimensions
- C. The main cap for the thrust bearing position was not fully seated before torquing, holding the cap slightly off the saddle
- D. The crankshaft counterweights are too large and are preventing the thrust bearing from fully contacting the journal

38. A vehicle with a GDI four-cylinder engine and 120,000 miles is brought in for an intake valve carbon cleaning service. The technician performs walnut shell blasting on all four intake valves. After reassembly, the engine starts and runs smoothly at idle. However, during the first road test, the engine hesitates noticeably during light-throttle acceleration between 1,500 and 2,500 RPM — a hesitation that was not present before the service. Which of the following is the MOST likely cause?

- A. Walnut shell debris left in the intake port is being drawn into the combustion chamber and causing misfires under load
- B. The cleaning process disturbed the intake manifold gasket seal and a vacuum leak has developed at one runner
- C. Walnut shell fragments lodged under one or more intake valve seats are preventing full valve closure under the higher cylinder pressures of acceleration
- D. The PCM's fuel trim adaptation is recalibrating to the improved airflow from the cleaned valves and will stabilize

39. A technician is diagnosing an engine that will not start after a timing belt replacement. The engine cranks at normal speed. There is no spark and no fuel injector pulse. The scan tool shows no communication with the PCM. All fuses and relays check good. Battery voltage is 12.6 volts. Which of the following is the MOST likely cause related to the timing belt service?

- A. A ground wire or PCM harness connector was left disconnected during the timing belt service and the PCM cannot power up
- B. The new timing belt has a shielding material that is interfering with the crankshaft position sensor signal
- C. The timing belt was installed with incorrect routing that damaged the crankshaft position sensor during installation

D. The PCM has entered an anti-theft lockout mode because the battery was disconnected during the service

40. A rebuilt engine exhibits a condition where the oil pressure is normal at all temperatures and engine speeds, but the lifter noise is excessive on multiple cylinders. The hydraulic lifters are new. Oil viscosity is correct. A stethoscope confirms ticking at four of eight lifter positions. The ticking is present at both cold and hot conditions. Which of the following is the MOST likely cause?

- A. The lifter bores in the block are worn and allow the lifters to tilt, preventing proper cam lobe contact
- B. The rocker arm geometry is incorrect because the wrong pushrods were installed — either too short or too long for the application
- C. The oil pump is delivering adequate pressure but insufficient volume to fill all eight lifters simultaneously
- D. The new lifters are from a batch with defective internal check valves and four of the eight are not pumping up

41. A customer reports that the engine makes a brief grinding noise the first time the key is turned to the start position each morning. The noise lasts approximately half a second and does not occur on subsequent starts throughout the day, even if the engine sits for several hours. The starter was replaced six months ago. Which of the following is the MOST likely cause?

- A. The flywheel ring gear has a damaged or missing tooth at one specific location where the starter pinion engages on the first morning start
- B. The starter drive overrunning clutch (Bendix mechanism) is not fully retracting when the engine is off overnight, and the grinding occurs as the pinion re-engages on the first start
- C. The ring gear has worn teeth that only cause grinding when the engine is cold and thermal contraction changes gear mesh clearance
- D. The starter solenoid is slow to engage on the first morning start because of overnight voltage drop at the solenoid contacts

42. A technician is measuring the deck height on a V6 engine block during a rebuild. The right bank deck measures 0.002 inches lower than the left bank deck. Both decks were measured at multiple points and are individually flat within 0.001 inches. The manufacturer does not specify a maximum difference between banks. Which of the following is the MOST appropriate action?

- A. Machine both decks to match the lower bank so both are at the same height from the crankshaft centerline
- B. Machine only the higher (left) bank to match the lower (right) bank for uniformity
- C. The 0.002-inch difference is within normal manufacturing tolerance and both banks can be used as-is
- D. Machine the lower (right) bank to raise it to match the higher bank using a build-up welding process

43. A customer reports that the engine has a persistent oil leak at the valve cover gasket that has been replaced three times in one year by three different shops. Each time, the leak stops for approximately one month and then returns at the same location — the rear driver-side corner of the valve cover. The PCV system is functional. Which of the following is the MOST likely root cause that all three shops have missed?

- A. The valve cover itself is warped or cracked at the rear corner and cannot maintain a seal regardless of how many times the gasket is replaced
- B. The head bolt nearest that corner has relaxed and the cover gasket surface on the head is no longer flat
- C. The PCV system is functional but the PCV baffle inside the valve cover is missing, creating localized pressure at the rear corner
- D. The engine mount on the driver side is allowing the engine to twist under load, flexing the valve cover

44. A V8 engine with 200,000 miles has oil pressure of 10 PSI at hot idle (specification minimum 10 PSI) and 35 PSI at 2,500 RPM (specification 40 to 65 PSI). The engine has no knocking. The customer wants to continue driving the vehicle for daily transportation. Which of the following is the MOST appropriate recommendation?

- A. The engine can be driven indefinitely because the idle pressure meets the minimum specification
- B. Replace the oil pump to restore the speed pressure to within specification before driving further
- C. Monitor the pressure at every oil change, shorten the oil change interval, and advise the customer that the engine is below specification at speed and is at elevated risk of bearing failure
- D. Immediately rebuild or replace the engine because the speed pressure below specification means failure is imminent

45. A freshly rebuilt engine produces normal compression on all cylinders and normal oil pressure. However, during the first road test, the technician notices the engine lacks power compared to the pre-failure performance. The engine does not misfire. Fuel pressure is correct. Ignition timing appears correct on the scan tool. A vacuum gauge reads 15 in. Hg at idle — lower than the expected 17 to 21 in. Hg. Which of the following should the technician investigate FIRST?

- A. The catalytic converter for a restriction that was not present before the rebuild was performed
- B. The camshaft timing marks to verify the timing chain was installed with correct alignment on all sprockets
- C. The intake manifold gasket for a vacuum leak that is reducing the effective vacuum across all cylinders
- D. The exhaust system for a kink or collapse that occurred during the engine removal and reinstallation

46. A technician is performing a compression test on a V6 engine and gets the following results: Cyl 1 = 155, Cyl 2 = 150, Cyl 3 = 90, Cyl 4 = 152, Cyl 5 = 155, Cyl 6 = 88 PSI. Cylinders 3 and 6 are significantly lower than the others. A wet test on cylinder 3 raises it to 95 PSI. A wet test on cylinder 6 raises it to 92 PSI. These two cylinders are on opposite banks and do not share a head gasket surface. Which of the following is the MOST likely diagnosis?

- A. Both cylinders have burned exhaust valves that occurred independently from a lean fuel condition
- B. Both cylinders have severely worn piston rings that failed from lubrication starvation on opposite banks
- C. A timing chain has jumped on both camshaft sprockets simultaneously, retarding valve timing on cylinders 3 and 6
- D. Both cylinders have valve sealing problems — the minimal wet test improvement (5 and 4 PSI respectively) confirms that the leak paths are at the valves, not the rings, and the two separate failures are coincidental or caused by a common factor such as a lean condition

47. A rebuilt engine produces an intermittent oil pressure fluctuation — the gauge reading drops 5 PSI and recovers over a 3-second period. The fluctuation occurs once every 2 to 3 minutes at idle. At 2,000 RPM, the fluctuation is not observed. Oil level and viscosity are correct. The engine sounds normal during the pressure dips. Which of the following is the MOST likely cause?

- A. A very small air bubble trapped in the oil system that intermittently reaches the oil pump pickup, momentarily reducing pump efficiency until the bubble passes through and normal suction resumes
- B. A worn main bearing that intermittently shifts the crankshaft and creates a momentary clearance spike
- C. The oil pressure relief valve is cycling between open and closed because the spring is at the borderline of its opening pressure
- D. An intermittent electrical fault in the oil pressure sending unit that causes momentary reading drops

48. A technician is testing a vehicle's cooling system and discovers that the radiator upper tank is significantly hotter than the lower tank — the temperature difference between inlet and outlet is approximately 40°F. The normal expected differential is 15 to 25°F for this system. The engine temperature is stable and within specification. Which of the following does this excessive temperature differential indicate?

- A. The thermostat is opening too late and allowing the coolant to overheat before reaching the radiator
- B. The water pump is circulating coolant faster than normal, not allowing enough time for heat exchange
- C. The radiator is functioning excessively well — removing more heat than normal from the coolant passing through it, which could indicate low coolant flow that allows extended contact time with the cooling tubes
- D. The radiator core is partially restricted, reducing coolant flow and allowing the reduced volume of coolant passing through to cool excessively before reaching the outlet

49. A customer reports that the engine idle speed has gradually increased from the normal 750 RPM to approximately 950 RPM over the past month. The engine runs smoothly at the elevated idle. No codes are stored. All engine mechanical tests are normal. The throttle body has been cleaned and the throttle plate closes fully. The IAC valve has been replaced with a new unit. Which of the following is the MOST likely remaining cause?

- A. A failing coolant temperature sensor that is reading lower than actual, causing the PCM to maintain a higher cold-idle strategy
- B. A vacuum leak that has gradually worsened over the past month and the PCM is compensating by adjusting idle parameters to maintain smooth operation
- C. The PCM idle adaptation has drifted and needs to be reset through a relearn procedure after the recent service work

D. The alternator is placing an excessive electrical load on the engine at idle that the PCM compensates for with higher RPM

50. A technician has completed a comprehensive engine rebuild. The engine has been through three heat cycles, passed all quality checks, and the customer has been driving the vehicle for 500 miles with no issues. At the 500-mile service, which of the following post-rebuild maintenance items is MOST critical?

A. A compression test to verify ring seating has progressed and compression is trending upward from the break-in readings

B. Retorque the cylinder head bolts to verify they have not lost clamping force during the initial thermal cycling

C. A cooling system flush to remove any debris that may have entered the coolant during the rebuild process

D. Change the engine oil and filter to remove break-in contaminants — assembly lubricant, microscopic wear particles from ring seating, and any residual honing debris

Practice Exam 16: Answer Key and Full Explanations

Domain Key: Each question's domain is noted in brackets for score tracking.

[A] = General Engine Diagnosis | [B] = Cylinder Head and Valve Train | [C] = Engine Block | [D] = Lubrication and Cooling Systems | [E] = Fuel, Electrical, Ignition, and Exhaust Systems

1. D — Cylinder 2 has two minor mechanical deficiencies: slight ring wear (faint air at oil filler) and a marginally leaking exhaust valve (faint air at tailpipe), with compression 2 PSI below the minimum specification. [A] At idle, where cylinder pressures and charge volumes are at their lowest, these combined leaks are enough to prevent consistent combustion. Above 1,500 RPM, the dramatically increased charge volume and higher combustion pressures overwhelm the small combined leakage — enough charge remains to sustain reliable combustion despite the mechanical shortcomings.

2. A — A vibration at idle that appeared immediately after a belt and tensioner replacement, with no misfires and a correct part number belt, points to a dimensional issue with the new belt. [E] Even within the same part number, manufacturing tolerances can produce a belt that is slightly longer or shorter than the previous one. This changes the operating position of the automatic tensioner arm — if it operates

outside its designed range, the tensioner's dampening characteristics change and it can introduce a harmonic vibration at idle frequency that the previous belt did not produce.

3. C — A steady hissing from the cylinder head near an exhaust port that does not respond to propane enrichment (ruling out a vacuum leak) and shows no visible exhaust gas escape (ruling out a manifold gasket leak) points to an internal crack between the exhaust port and a coolant passage. [D] Coolant seeping through the crack contacts the extremely hot exhaust port wall and instantly vaporizes, producing the continuous hissing sound. The propane test is negative because this is not an air leak into the intake — it is a coolant-to-exhaust breach that produces steam, not a vacuum disturbance.

4. B — A single connecting rod big-end bore that is 0.001 inches out-of-round while all others are round, with correct bolts at correct torque, indicates damage at the cap-to-rod mating surface specific to that rod. [C] Fretting damage — roughened surfaces from micro-movement under cyclic loading during the previous engine's operation — prevents the cap from seating squarely against the rod body. The uneven seating produces an oval bore when the cap is torqued. The rod must be reconditioned (resized) or replaced to restore a round bore.

5. D — A sudden increase in oil consumption from near-zero to one quart per 400 miles that began one week after a PCV valve replacement is a timing coincidence too strong to ignore. [A] An incorrect PCV valve — one rated for a different engine with a higher flow rate — can create excessive vacuum in the crankcase that pulls oil vapor and liquid oil mist into the intake manifold at a rate far higher than the correct valve would allow. Verifying the PCV valve part number against the manufacturer's specification is the quickest and most logical first check.

6. A — Both technicians are correct. [B] Technician A correctly notes that a crack between a combustion chamber and a coolant passage can be very small initially, producing only minor coolant seepage that takes weeks or months to cause noticeable symptoms. Technician B correctly identifies that cracks between exhaust valve seats — the thinnest, hottest area of the head — propagate rapidly because the extreme thermal cycling (heating to 1,200°F+ during combustion, cooling between events) accelerates crack growth with every engine cycle.

7. B — Oil pressure that drops from 28 PSI to 20 PSI at hot idle over the first 5,000 miles of a rebuilt engine, while remaining above the 15 PSI minimum and producing 48 PSI at speed, falls within the expected range of post-break-in bearing wear-in. [D] New bearing surfaces undergo a controlled micro-wear process during the first several thousand miles as the soft overlay material conforms to the journal. This normal process slightly increases clearances, and the rate of pressure decrease decelerates as the bearings reach their equilibrium running condition.

8. C — A P0420 code on an engine with no misfires, no oil consumption, and a properly switching upstream O2 sensor — but with a downstream sensor that nearly mirrors the upstream — on a converter replaced only 8,000 miles ago should first raise the question of converter quality. [E] Many aftermarket catalytic converters do not contain sufficient catalyst material or washcoat to meet OEM efficiency standards, particularly on vehicles with stricter emissions monitoring thresholds. Verifying whether the replacement was an OEM-equivalent or a budget aftermarket unit is the most targeted first step before replacing components.

9. D — The 23 PSI drop from cold to hot idle (45 to 22) is a completely normal consequence of oil viscosity change with temperature. [D] Cold oil is thick and resists flow through bearing clearances, creating high back-pressure that the gauge reads as elevated pressure. As the oil reaches operating temperature and thins to its designed viscosity, it flows more easily through the same clearances, and the measured pressure drops proportionally. The 50 PSI reading at 2,500 RPM hot confirms the pump and bearings are functioning correctly. All readings are within specification.

10. A — A single piston crown that is visibly cleaner than all others — appearing steam-cleaned with no carbon — is the hallmark of coolant entering that specific cylinder's combustion chamber. [A] The coolant's steam-cleaning action washes carbon deposits off the piston during every combustion event, leaving the crown conspicuously clean compared to the carbon-coated pistons in cylinders that are not receiving coolant. This finding confirms cylinder 4 is the location of the head gasket breach to a coolant passage.

11. C — A valve seat concentricity runout of 0.003 inches TIR exceeds the 0.002-inch maximum specification, meaning the seat is not concentric with the valve guide bore. [B] An eccentric seat prevents uniform contact between the valve face and the seat around the full 360-degree circumference, creating a leak path where the contact is incomplete. The seat must be recut using a properly centered pilot seated in the guide bore. Lapping cannot correct a concentricity problem — it can only improve the contact within the existing cut geometry.

12. D — Oil pressure of 9 PSI at hot idle — 1 PSI below the 10 PSI minimum — with a 500-mile-old oil change warrants investigation rather than an immediate pump replacement or engine teardown. [D] The first step is to verify the basics: confirm the oil filter is the correct application (a wrong filter with a lower bypass pressure can reduce system pressure), verify the drain plug is sealed (low oil level drops idle pressure), and then systematically investigate whether the cause is a worn pump, worn bearings, or an incorrect component from the recent service.

13. B — All findings form a connected chain: worn main bearings produce the thump that does not change with cylinder disable (main bearings support all cylinders), the excessive bearing clearance

allows oil to escape faster than the pump can supply at idle (producing the below-spec 8 PSI reading), and the worn bearings allow increased crankshaft movement that generates elevated crankcase pressure, which forces oil past the rear main seal. [A] The rear seal leak is a symptom of the bearing wear, not a separate problem.

14. A — On most engines where the connecting rods are identical in specification — same part number, same weight, same dimensions, and no directional features — swapping two rods' positions has no mechanical effect. [C] The rods are interchangeable. If the rods had directional features (offset wrist pins, directional oil squirt holes, or specific weight-matching requirements for specific positions), the swap would matter. The technician should verify whether the rods have any directional requirements, but on most engines with identical rods, the engine can be started as assembled.

15. D — The overflow tank gradually emptying while the radiator stays full describes a classic stuck-closed vacuum valve on the radiator cap. [D] During each heat cycle, coolant expansion pushes coolant through the cap's pressure valve into the overflow tank — this works normally. When the engine cools, the cap's vacuum valve should open to draw coolant back from the overflow. If the vacuum valve is stuck closed, the coolant stays in the overflow tank. Over many heat cycles, the overflow tank gradually empties as the coolant is not drawn back, while the radiator maintains its level because it is refilled from the recovery cycle.

16. C — Both technicians correctly describe the valve timing events that create valve overlap near TDC between the exhaust and intake strokes. [B] Technician A correctly describes the intake valve opening before TDC on the exhaust stroke — this is intake valve opening lead, which takes advantage of the exhaust gas momentum to begin drawing fresh charge. Technician B correctly describes the exhaust valve closing after TDC on the intake stroke — this is exhaust valve closing lag, which allows the incoming intake charge to help scavenge the last exhaust gas.

17. A — On an OHV engine with hydraulic lifters and non-adjustable rocker arms, visible lash at one rocker arm tip while the engine is running confirms the hydraulic lifter at that position is not pumping up to its designed zero-lash condition. [B] A properly functioning hydraulic lifter automatically takes up all clearance — if lash is visible, the lifter has failed internally. The most likely defect on a new replacement lifter is a manufacturing defect in the check valve, a scored plunger bore, or debris that entered during installation. The lifter must be replaced.

18. B — A cooling system that holds 16 PSI perfectly when cold but builds pressure to 22 PSI and continues climbing after the engine reaches operating temperature — exceeding the cap's rated relief pressure — indicates an additional pressure source is adding to the coolant system pressure beyond what thermal expansion alone can produce. [D] Combustion gas entering the coolant through a head gasket breach adds gas pressure on top of the normal thermal expansion pressure. The cap's relief valve cannot

keep up with the continuous influx of high-pressure combustion gas, and system pressure climbs above the cap's rating.

19. D — A smooth, localized low spot on the block deck — not a scratch, gouge, or crack — is most consistent with a casting porosity defect that was filled during factory machining or quality control but has since recessed below the surrounding surface. [C] Factory block castings occasionally have small porosity voids that are filled with impregnation compound or surface material during manufacturing. Over years of thermal cycling and clamping pressure from the head bolts, the filler material can shrink or recede, leaving the smooth depression. The block deck may need to be resurfaced to restore a uniform flat surface.

20. B — A single brief stumble that occurs at exactly the same point (approximately 5 seconds) after every cold start — both cold and warm — and does not recur is most consistent with a programmed PCM event that momentarily disrupts the idle. [A] The EVAP purge system performs a brief initial purge test during cold start, and if the canister contains a high concentration of fuel vapor, the sudden introduction of the vapor bolus into the intake manifold momentarily enriches the mixture beyond the PCM's ability to compensate in real time, producing the brief stumble.

21. A — Bank 2 running 15°F hotter than bank 1 with equal fuel trims and equal compression across all cylinders rules out a fueling or compression imbalance as the cause. [A] A partially restricted exhaust manifold runner on bank 2 increases exhaust gas velocity and turbulence at the restriction point, converting kinetic energy to heat and raising the measured exhaust gas temperature. The restriction also creates back-pressure that the engine must work against, generating additional heat. The identical fuel trims confirm the PCM is fueling both banks equally.

22. C — The key finding is the minimal wet test improvement — only 5 to 8 PSI across all cylinders. [A] If rings were the primary cause of the low compression, the oil would seal the ring-to-bore gap and produce a significant improvement (20+ PSI typically). The minimal improvement means the compression loss is not at the ring-to-bore interface. Combined with the 12-degree retarded timing from chain stretch, the diagnosis is clear: the stretched chain has retarded the camshaft, causing the intake valves to close too late — allowing charge to escape back through the intake before full compression can build.

23. D — A popping noise from the intake manifold during cranking that occurs once every few crank revolutions and stops once the engine starts points to incorrect valve timing that positions one or more intake valves slightly open during the compression stroke at cranking speed. [A] As the piston rises on what should be a sealed compression stroke, the partially open intake valve allows the compressed charge to push back through the port into the manifold, producing the audible pop. Once the engine

starts and is running at normal speed, the dynamic conditions may compensate enough to prevent the backfire.

24. A — Both technicians describe valid and complementary post-rebuild practices. [D] Technician A correctly identifies the purpose of the early 500-mile oil change: the first oil collects the highest concentration of break-in contaminants — assembly lubricant, microscopic metal from ring seating, and any honing grit that escaped cleaning. Removing this oil early protects the bearings. Technician B correctly recommends the magnetic drain plug as an additional safeguard that captures ferrous particles too small for the filter but large enough to cause bearing damage.

25. B — A crack from the combustion chamber to an oil drain-back passage allows high-pressure combustion gas — containing carbon, soot, and acidic combustion byproducts — to be forced into the oil drain-back channel during each power stroke. [D] These combustion byproducts mix with the engine oil as it drains back to the pan, contaminating and darkening the oil at a rate far beyond normal. The gray discoloration is the characteristic appearance of oil heavily contaminated with combustion carbon. No coolant is involved because the crack path goes to an oil passage, not a coolant passage.

26. D — A front seal wear line that is off-center — not concentric with the crankshaft centerline — indicates the surface the seal rides on is not rotating true to center. [D] The harmonic balancer is the sealing surface for the front crankshaft seal. If the balancer is running eccentric on the snout — from a worn keyway, improper installation, or a damaged inner bore — the seal lip is forced to follow an eccentric path that creates uneven wear and eventually a leak. Checking balancer runout with a dial indicator confirms the eccentricity.

27. C — The relative compression test detected a 15% lower current spike on cylinder 4 compared to the other five cylinders — meaning the starter encountered less resistance on cylinder 4's compression stroke. [A] This indicates cylinder 4 has slightly lower compression than the others. The standard compression test may show all cylinders "within specification" because it measures absolute values, but the relative test directly compares cylinders to each other and is more sensitive to small differences. The marginally lower compression on cylinder 4 is enough to cause the subtle idle roughness without triggering a diagnostic code.

28. A — A single clunk from the front engine area that occurs only when the vehicle comes to a complete stop — not during driving, acceleration, or stationary idle — points to a broken or severely deteriorated engine mount. [A] When the vehicle decelerates to a stop, the engine's inertia causes it to shift forward against the mount. If the mount's rubber element is broken or collapsed, the engine moves further than designed and impacts the mount's metal stop with an audible clunk. The noise occurs at the

specific moment of full stop because that is when the deceleration force and the engine's inertial shift are greatest.

29. B — Three cylinders at or above the 145 PSI minimum and three marginally below (138–142 range), with oil pressure in the lower portion of the specification range at both idle and speed, describe an engine with moderate wear consistent with 155,000 miles of operation. [A] The engine is not failing — all parameters are at or near their specification limits — but it is clearly worn. The customer should understand that the engine has limited remaining life before compression and oil pressure drop below specification, and should factor the cost of a potential future rebuild into the purchase decision.

30. A — On a freshly rebuilt engine, all cylinders should contribute equally — if one exhaust port is pulsing weakly and running cooler than the others, that cylinder is not producing normal combustion. [C] The technician should shut down immediately and investigate the most common first-start issues: a disconnected or loose spark plug wire, an unplugged fuel injector connector, or a compression problem on that cylinder. Continuing to run an engine with one non-contributing cylinder during break-in can cause uneven ring seating and camshaft lobe damage from the unbalanced combustion forces.

31. D — At 45,000 miles with proper oil maintenance, timing chain stretch is unlikely — chains typically last 100,000+ miles with correct oil. [A] The P0016 and P0011 codes together indicate the intake camshaft is not reaching or holding its commanded position. The most probable cause at this mileage is a VVT oil control valve failure (clogged screen, failed solenoid) or the intake cam phaser developing internal wear (worn vane seals, damaged locking pin). The oil control valve is the most accessible and least expensive component to test first.

32. A — Rapid oil pressure gauge oscillation at idle that smooths out at higher RPM is a normal characteristic of many oil pump designs — particularly gear-type pumps that produce slight pressure pulsations as each gear tooth engages and disengages. [D] At idle, the pump rotates slowly enough that each tooth's pressure pulse is spread over enough time for the gauge needle to respond individually. At higher RPM, the pulsation frequency exceeds the gauge's mechanical response time and the needle averages out to a steady reading. The engine sounding normal confirms this is a gauge response phenomenon.

33. C — A wastegate that is stuck partially open despite the actuator rod moving freely indicates the valve itself is not following the actuator's command. [A] Carbon and soot buildup on the wastegate valve and seat — common on turbocharged engines — can physically hold the valve open even when the actuator arm moves to the closed position. The rod moves freely because the carbon creates a mechanical bind at the valve, not at the actuator. Inspecting the wastegate valve for carbon buildup and cleaning or replacing it is the logical next step after eliminating the other causes.

34. B — Air heard exclusively at the tailpipe during leak-down (no air at oil filler, intake, or coolant), compression below minimum specification, and minimal wet test improvement (only 3 PSI) together form a definitive exhaust valve diagnosis. [A] The tailpipe-only air path confirms the leak is through the exhaust valve to the exhaust system. The minimal wet test improvement eliminates rings — if rings were the cause, oil would seal the gap significantly. The below-spec compression confirms the leak is large enough to affect cylinder performance. The exhaust valve is burned, bent, or otherwise not seating.

35. D — Ethylene glycol antifreeze has a lower thermal conductivity and lower specific heat capacity than water. [D] A 50/50 mixture balances freeze protection with heat transfer efficiency. A 65/35 mixture with excess antifreeze relative to water reduces the mixture's ability to absorb and transfer heat — each unit of coolant flowing through the engine carries less heat to the radiator than a properly mixed 50/50 blend. The engine stabilizes at a slightly higher temperature because the cooling system's heat rejection capacity is reduced. Correcting the mixture to 50/50 resolves the elevated temperature.

36. A — Both technicians describe critical aspects of flat-tappet camshaft break-in that must be performed together. [B] Technician A correctly identifies the lubricant requirement: moly-based break-in paste on every cam lobe provides the extreme-pressure boundary lubrication needed during the first minutes when the lobe-to-lifter interface is under maximum stress with minimal oil film. Technician B correctly identifies the RPM requirement: running at 2,000 to 2,500 RPM ensures adequate oil splash reaches all cam lobes and prevents the lifters from dwelling on any single lobe at the slow speeds of idle.

37. B — Crankshaft end play of 0.012 inches exceeds the 0.010-inch maximum specification by 0.002 inches. [C] The thrust bearing's flanges are responsible for controlling axial crankshaft movement. If the bearing has insufficient flange width, incorrect thickness, or is not the correct application for the crankshaft's thrust journal dimensions, the flanges cannot limit axial movement to the designed range. The thrust bearing must be replaced with the correct specification unit — or an oversize thrust bearing if the crankshaft's thrust surfaces are also worn.

38. C — A hesitation during light-throttle acceleration that developed immediately after an intake valve cleaning service — and was not present before — points to debris from the cleaning process affecting valve sealing. [B] Walnut shell fragments that lodged under one or more intake valve seats prevent those valves from closing fully. At idle, the lower cylinder pressures may not expose the leak. Under the increased cylinder pressures of acceleration, the unseated valve leaks enough compression to produce the hesitation. The head must be removed and the valves and seats inspected and cleaned.

39. A — An engine that cranks normally but has no spark, no injector pulse, and no scan tool communication after a timing belt service points to a basic electrical connection that was disrupted during the service. [E] No PCM communication means the PCM is not powering up — not a timing or

sensor issue. During timing belt replacement, the technician must often disconnect harness connectors, move wiring aside, and sometimes disconnect grounds to gain access. A ground wire, PCM power connector, or main engine harness connection that was not reconnected prevents the PCM from operating entirely.

40. D — Excessive lifter noise on four of eight positions on a rebuilt engine with new lifters, correct oil viscosity, and normal oil pressure points to defective lifters from the replacement batch. [B] If the oil system is delivering adequate pressure (confirmed by the gauge reading) and the pushrods and rocker arm geometry are correct, the lifters themselves are the remaining variable. A manufacturing batch with defective internal check valves — either from contamination during assembly or a dimensional tolerance error — would affect a random subset of the batch. The four noisy lifters should be replaced.

41. B — A grinding noise only on the first morning start that does not recur throughout the day — even after several hours of sitting — indicates a condition specific to overnight sitting that does not develop during shorter rest periods. [E] The starter drive's overrunning clutch mechanism may not be fully retracting after the last shutdown of the day. Overnight, the drive remains in partial engagement with the ring gear. On the first morning start, the rotating ring gear grinds against the partially engaged pinion for the brief moment before the drive mechanism fully engages or retracts. During the day, shorter sitting periods do not allow the drive to settle into this position.

42. D — A 0.002-inch difference between the right and left bank deck heights on a V6 engine is within normal manufacturing tolerance for most production engine blocks. [C] V-type engine blocks are cast and machined with each bank as a separate surface, and minor height differences are accommodated by the head gasket design. Machining both decks to match an arbitrary common height removes material unnecessarily and alters the compression ratio and piston-to-head clearance on the taller bank. Both banks can be used as-is.

43. A — A valve cover gasket leak that recurs at the same corner after three replacements by three different shops indicates the gasket is not the problem — the sealing surface is. [A] The most likely root cause is that the valve cover itself is warped, cracked, or has a casting defect at the rear driver-side corner that prevents it from maintaining a seal regardless of how many times the gasket is changed. Placing the valve cover on a flat surface and checking for warp with a straightedge and feeler gauge at the rear corner would reveal the defect.

44. C — Oil pressure of 10 PSI at hot idle (at the absolute minimum specification) and 35 PSI at speed (below the 40 PSI minimum) confirms the engine is worn beyond specification at speed but barely within specification at idle. [D] The engine is not in immediate danger of catastrophic failure (no knocking), but it is operating below specification under load. The most appropriate recommendation is honest monitoring: shorten the oil change interval to minimize contaminant exposure, check oil pressure at every service, and inform the customer that the engine has an elevated risk of bearing failure that increases with each mile.

45. B — A rebuilt engine that lacks power with vacuum reading 2 to 4 in. Hg lower than expected, no misfires, correct fuel pressure, and apparently correct timing on the scan tool should first be checked at the physical timing marks. [B] The scan tool displays the PCM's calculated timing based on sensor inputs — it does not verify that the camshaft is physically positioned correctly relative to the crankshaft. A timing chain installed one tooth off produces uniformly retarded valve events that reduce compression, power, and vacuum, but the scan tool timing display may appear normal because the PCM is basing its calculation on the (now offset) sensor positions.

46. D — Two non-adjacent cylinders on opposite banks with very low compression and minimal wet test improvement (confirming valve leakage rather than ring wear) that do not share a head gasket surface represents two independent valve failures. [A] The minimal wet test improvement on both cylinders (5 and 4 PSI respectively) is the key finding — oil cannot seal a valve leak. The most likely common cause is a lean fuel condition affecting multiple cylinders that caused both exhaust valves to overheat and burn. A shared systemic condition (lean fueling, incorrect timing) can produce simultaneous valve failures on separate banks.

47. A — An intermittent, self-resolving oil pressure dip of 5 PSI that occurs once every 2 to 3 minutes at idle — with no noise change and no dip at higher RPM — is consistent with a small trapped air bubble in the oil system. [D] The bubble circulates through the oil, and each time it reaches the pump pickup, the pump momentarily draws air mixed with oil, reducing its output efficiency for one or two pump revolutions. The pressure dips, the bubble passes through, and normal suction and pressure resume. At 2,000 RPM, the higher flow velocity prevents the bubble from disrupting pump suction.

48. C — An excessive temperature differential between the radiator inlet and outlet (40°F versus the expected 15 to 25°F) means the coolant passing through the radiator is losing more heat than normal. [D] A partially restricted radiator core reduces the volume of coolant flowing through the tubes. The reduced volume of coolant spends more time in contact with the cooling tubes and fins, losing more heat per unit volume. The result is an outlet temperature that is much cooler than the inlet — the excessive differential is a signature of restricted flow, not enhanced cooling performance.

49. B — A gradually increasing idle speed over one month, with no codes, a clean throttle body, a new IAC valve, and a fully closing throttle plate, points to a vacuum leak that has been slowly worsening. [A] As the leak grows, unmetered air enters the intake manifold, and the PCM compensates by adjusting its idle control parameters to maintain smooth operation — effectively raising the idle speed to accommodate the additional airflow. The absence of codes is expected because the PCM views the higher idle as its own adaptation, not a fault. Performing a smoke test to locate the leak is the next diagnostic step.

50. D — The 500-mile oil and filter change is the single most critical post-rebuild maintenance item because the first oil collects the highest concentration of contaminants generated during the break-in process. [D] Assembly lubricant residue, microscopic metal particles shed from new ring faces seating against the honed bore, bearing overlay material conforming to the journal, and any honing grit that escaped the block cleaning process all accumulate in the first 500 miles. Removing this oil and its contaminant load early protects the new bearing and ring surfaces for the life of the rebuild.