PRACTICE EXAM 17: ASE A1 ENGINE REPAIR SIMULATION (50 QUESTIONS)

1. A technician is diagnosing a V6 engine with an intermittent misfire on cylinder 5 that occurs only during light-throttle cruise between 35 and 45 mph. The misfire does not occur at idle, during hard acceleration, or at highway speed. The spark plug, coil, and injector have been swapped and the misfire stays on cylinder 5. Compression is 145 PSI — at the minimum specification. A leak-down test shows 14% leakage with faint air at the tailpipe and very faint air at the oil filler. Which of the following BEST explains why this misfire occurs only during light-throttle cruise?

A. The exhaust valve leak is severe enough to cause misfires at all conditions but the PCM masks the misfire at other operating modes through fuel enrichment

B. The combined minor valve and ring leakage creates a marginal cylinder that fails only during the specific low-pressure, low-charge-volume conditions of light-throttle cruise where combustion is least robust

C. The VVT system positions the exhaust cam at a specific angle during light cruise that worsens the exhaust valve leak on that cylinder

D. The fuel injector on cylinder 5 has a flow calibration error that is only exposed during the specific pulse width used at light cruise conditions

2. A customer brings in a vehicle with an engine that cranks normally but will not start. The fuel pump primes and fuel pressure reaches 58 PSI at key-on — within specification. A spark test shows strong spark on all four cylinders. A compression test shows all cylinders between 148 and 155 PSI — within specification. The engine was running perfectly when parked 12 hours ago. Which of the following should the technician check NEXT?

A. The crankshaft position sensor signal during cranking to verify the PCM is receiving a valid RPM reference

B. The coolant temperature sensor reading to verify the PCM is using the correct cold-start fuel enrichment

C. The exhaust for a complete blockage that is preventing the cylinders from expelling gas during cranking

D. Whether the fuel injectors are receiving their pulse signal from the PCM — fuel pressure alone does not confirm fuel is being delivered to the cylinders

3. A rebuilt engine develops an oil pressure fluctuation that is temperature-dependent. At cold idle, the pressure is a rock-steady 55 PSI. As the engine warms to operating temperature, the pressure gradually drops and begins oscillating between 18 and 24 PSI at hot idle — a 6 PSI swing approximately twice per second. At 2,000 RPM hot, the pressure is steady at 48 PSI. Which of the following is the MOST likely cause of the hot idle oscillation?

A. The oil pickup tube O-ring has developed a marginal seal that allows air ingestion only when the thinner hot oil reduces the pump's ability to maintain a vacuum seal at the pickup

B. The oil pressure relief valve spring has weakened and oscillates between open and closed at the borderline pressure of hot idle

C. The main bearings have excessive clearance that produces pulsating flow at idle but is overwhelmed by the pump's higher output at speed

D. The oil pump gears have worn and produce an intermittent pressure pulse at the low rotational speed of idle

4. A technician is performing a valve adjustment on a DOHC engine with shim-over-bucket solid lifters. The number 3 exhaust clearance measures 0.004 inches — below the 0.010 to 0.012 inch specification. The technician calculates that a thinner shim is needed to increase clearance. The current shim is 2.80 mm. A 2.65 mm shim is selected. After installation, the measured clearance is 0.010 inches. Which of the following describes the resulting valve operation?

A. The clearance is now too loose and a slightly thicker shim should be selected to bring it to mid-specification

B. The clearance is at the absolute minimum of the specification and may tighten further as the valve seat wears

C. The clearance of 0.010 inches is within the specification range and the valve will operate correctly

D. The thinner shim will cause the bucket to sit too high in the bore and contact the cam base circle prematurely

5. A six-cylinder engine has been running with a known coolant leak for several weeks. The customer has been adding coolant regularly. A block test is positive at 2,500 RPM. The engine oil appears normal

on the dipstick. The technician removes the cylinder head and finds the head gasket breached between the number 4 combustion chamber and a coolant passage. The piston crown on cylinder 4 is notably cleaner than the others. However, the technician also notices that the block deck surface near cylinder 4 has a greenish stain in the area around the gasket breach. Which of the following is the significance of the greenish stain on the block deck?

A. The stain is residual dye from a previous UV dye test that the customer did not mention to the technician

B. The stain is coolant residue that has been pressurized against the block deck surface by combustion gas forcing through the gasket breach

C. The stain indicates the block deck itself is porous at that location and is allowing coolant to seep through the casting

D. The stain is a chemical reaction between the aluminum head gasket fire ring and the cast iron block surface

6. Technician A says that a catalytic converter's internal temperature can exceed 1,400°F during normal operation and that this heat can cause the converter's substrate to melt if raw fuel enters the converter from a misfiring cylinder. Technician B says that a glowing red catalytic converter housing visible from underneath the vehicle is always a sign that the converter has failed internally. Who is correct?

A. Technician A only

B. Technician B only

C. Both Technician A and Technician B

D. Technician A is correct about the temperature and fuel damage, but Technician B is incorrect because a glowing converter indicates raw fuel is reaching it — the converter itself may be functioning but is being overwhelmed by the upstream misfire

7. A vehicle owner reports that the engine has developed a gradual loss of power over the past 15,000 miles. The vehicle now feels sluggish and fuel economy has decreased approximately 20%. No check engine light is on. A compression test shows all six cylinders between 118 and 125 PSI — below the 145 to 170 specification. A vacuum gauge reads 14 in. Hg at idle. A timing chain stretch measurement shows 8 degrees of camshaft retardation from specification. Which of the following BEST describes the relationship between the timing chain stretch and the other findings?

A. The stretched timing chain has retarded the camshaft, which causes the intake valves to close late and reduces the effective compression ratio — explaining the uniformly low compression, the low vacuum, the power loss, and the poor fuel economy as one interconnected problem

B. The compression loss is from ring wear, the vacuum loss is from the timing chain, and the symptoms are from two separate deteriorating systems

C. The timing chain stretch only affects ignition timing on distributor engines, not compression or vacuum

D. The 8-degree retardation would improve efficiency by allowing more complete combustion and the symptoms must have another cause

8. A technician is rebuilding an engine and discovers that the number 2 piston has a small but visible dent on the piston crown — approximately 3 mm in diameter and 0.5 mm deep. The dent appears to have been caused by a foreign object that entered the combustion chamber at some point during the engine's previous operation. No cracks radiate from the dent. Which of the following is the correct action?

A. Replace the piston because any surface irregularity on the crown disrupts the designed combustion pattern

B. Fill the dent with high-temperature metallic epoxy and sand it flush to restore the original crown profile

C. Install the piston as-is because a small dent without cracks does not affect the structural integrity or function of the piston

D. Regrind the piston crown surface on a lathe to remove the dent and restore a smooth, uniform surface

9. A customer reports that the engine runs normally except for a condition that occurs when the engine is idling in Drive with the air conditioning on and the brake pedal pressed firmly on hot days. Under this specific triple-load condition, the engine RPM drops to approximately 450 and the engine shakes before recovering. Compression is within specification. Oil pressure is within specification. Which of the following is the MOST likely cause?

A. A single cylinder with marginal compression that cannot sustain combustion under the combined parasitic loads

B. The engine's idle reserve capacity is insufficient to maintain stable RPM under the simultaneous demands of the A/C compressor, torque converter load, and brake booster vacuum draw

C. The brake booster has a ruptured diaphragm that creates a massive vacuum leak when the brake is pressed

D. The A/C compressor clutch is engaging intermittently rather than steadily, creating load spikes that overwhelm the idle control

10. A technician discovers during an engine rebuild that the crankshaft has been previously welded — there is a visible weld repair on the counterweight opposite the number 3 rod journal. The weld appears professionally done with smooth grinding. The crankshaft passes Magnaflux inspection. All journal measurements are within specification. Which of the following is the correct action?

A. Install the crankshaft because it passes all inspection criteria and the weld repair appears professionally done

B. The crankshaft can be used only if it passes a dynamic balance check to verify the weld has not altered the balance

C. Regrind all journals to the first undersize as a precaution against hidden subsurface damage near the weld

D. Replace the crankshaft because a welded counterweight compromises the metallurgical integrity and fatigue resistance of the crankshaft regardless of how well the repair appears

11. A four-cylinder engine with 170,000 miles has the following compression results: Cyl 1 = 140, Cyl 2 = 138, Cyl 3 = 60, Cyl 4 = 142. The specification is 140 to 160 PSI. A wet test on cylinder 3 raises the reading to 65 PSI. A leak-down test on cylinder 3 shows 48% leakage with air heard equally at both the intake manifold and the exhaust tailpipe. No air is heard at the oil filler or in the coolant. Which of the following conditions could cause simultaneous air leakage at both the intake and exhaust on a single cylinder?

A. The camshaft timing has jumped significantly on that cylinder's bank, positioning both valves partially open at what should be TDC compression

B. Both the intake and exhaust valves on cylinder 3 have independently burned through from a lean fuel condition

C. A cracked cylinder head that has fracture paths from the combustion chamber to both the intake and exhaust ports

D. The piston rings on cylinder 3 have failed so completely that compression escapes through the crankcase to both manifolds

12. A customer brings in a vehicle stating that the engine has been using coolant for six months but the engine oil has always remained clean. No external leaks have ever been found. The exhaust produces intermittent white puffs only on cold start. A block test at idle is negative. A block test at 2,500 RPM is negative. The technician is about to declare the cooling system healthy. Which of the following additional tests could still detect a very small gasket breach that the block tests missed?

A. A UV dye test in the coolant with a 500-mile drive and subsequent UV inspection of the exhaust system components

B. An extended 24-hour cooling system pressure test to detect a leak too small for the standard 20-minute test

C. A cylinder-by-cylinder coolant pressure test where the technician pressurizes the cooling system and performs a leak-down test on each cylinder individually, looking for coolant level drop when each cylinder is pressurized

D. A laboratory analysis of the exhaust condensate collected at the tailpipe, tested for the presence of ethylene glycol or its combustion byproducts

13. A rebuilt engine produces a noticeable vibration at 2,200 RPM that was not present in the original engine before the rebuild. The vibration is felt through the steering wheel and seats. It disappears above 2,500 RPM and below 2,000 RPM. The engine runs smoothly on all cylinders with no misfires. All engine mounts are new. The serpentine belt, tensioner, and pulleys are all new. Which of the following is the MOST likely cause?

A. The replacement crankshaft position sensor is producing a slightly irregular signal at 2,200 RPM that causes a timing jitter

B. The harmonic balancer was disturbed or replaced during the rebuild and is no longer properly damping the crankshaft's natural torsional resonance at 2,200 RPM

C. The flywheel or flexplate lost a balance weight during removal and now has a rotational imbalance that resonates at 2,200 RPM

D. The rebuilt engine has a slightly different compression ratio that produces a combustion-induced vibration at this specific RPM

14. A technician is inspecting the cylinder bores on an engine block that overheated severely before being torn down. All six bores show normal wear patterns in the lower two-thirds of the bore. However, the upper one-third of each bore — the area nearest the deck surface — has a distinctly different texture: the crosshatch is gone, replaced by a smooth, almost polished surface with faint vertical scoring. Which of the following BEST explains this upper-bore condition?

A. The crosshatch in the upper bore was worn away by normal piston ring travel over the engine's service life

B. The rings developed excessive end gap from the overheating event and allowed blowby that washed the oil film from the upper bore

C. The upper bore lost its oil film during the overheating event and the pistons scuffed against the dry bore wall

D. The pistons expanded beyond their designed clearance during the overheating, contacting the upper bore wall and polishing the crosshatch off through metal-to-metal contact during the thermal expansion event

15. A customer reports that the engine occasionally produces a single backfire through the air intake during cold start. The backfire occurs approximately once per week and is followed by normal engine operation. No codes are stored. The engine has a DOHC design with VVT on both camshafts. Oil changes are performed at the correct interval with the specified oil. Which of the following is the MOST likely cause?

A. A VVT cam phaser that intermittently drains oil and rests in an incorrect position, causing momentary valve timing misalignment that pushes a compression charge back through the intake on the first cranking revolution

B. A fuel injector that randomly sticks open during key-off and floods one cylinder with fuel that ignites prematurely during cranking

C. A cracked spark plug insulator that intermittently short-circuits the spark to ground instead of across the electrode gap

D. A weak valve spring that intermittently fails to close the intake valve before the compression stroke begins during cranking

16. A technician is measuring the main bearing oil clearance on a rebuilt engine using Plastigage. After torquing the number 4 main cap and removing it, the Plastigage strip is widest at the center of the journal and narrowest at both edges. This tapered pattern indicates the strip was compressed more at the edges and less at the center. Which of the following does this pattern reveal about the journal?

A. The journal has a slightly barrel-shaped profile — larger in diameter at the center than at the edges

B. The journal has normal geometry and the tapered Plastigage pattern is an expected result of the measurement technique

C. The journal has a slight hourglass profile — smaller in diameter at the center than at the edges, meaning the center has worn more than the ends

D. The main cap was torqued unevenly and the measurement must be repeated after verifying uniform torque

17. A vehicle with a turbocharged engine is brought in with a complaint of a whistling noise that increases with boost pressure. The noise is not present at idle or during naturally aspirated operation. A boost leak test using regulated shop air shows no leaks in the charge air piping. The turbocharger shaft has no measurable play. Which of the following should the technician check NEXT?

A. The exhaust manifold gasket for a leak that is only audible when exhaust volume increases under boost

B. The turbocharger compressor wheel for damage — a chipped or cracked blade produces a whistling noise under boost as the damaged blade disrupts smooth airflow at high rotational speed

C. The intercooler for an internal restriction that produces a whistling as compressed air is forced through a narrowed passage

D. The wastegate for a vibrating actuator rod that produces a whistle when subjected to the vibration of boost pressure operation

18. A rebuilt engine has been running for 1,500 miles. The customer reports the oil has a slight gasoline odor. The oil level is at the full mark — not elevated. The engine has no misfires, no codes, and runs perfectly. The customer drives primarily in cold weather with frequent short trips of 5 miles or less. Which of the following is the MOST likely cause?

A. Fuel condensation from short-trip cold-weather driving — the engine never reaches full operating temperature to evaporate accumulated fuel from the oil through the PCV system

B. A leaking fuel injector that drips fuel into one cylinder during key-off periods overnight

C. A cracked fuel pressure regulator diaphragm that allows fuel to enter the intake vacuum system at all times

D. Excessive fuel enrichment from a faulty ECT sensor that reads colder than actual temperature at all times

19. A technician is evaluating a crankshaft that was removed from an engine with a known main bearing failure at position number 3. The number 3 main journal is scored and heat-discolored. All other main

journals appear smooth. The technician measures all main journals: numbers 1, 2, 4, and 5 are within standard specification. Number 3 is 0.008 inches below standard. The maximum undersize regrind is 0.030 inches. Which of the following is the correct repair approach?

A. Regrind all five main journals to the same undersize for uniformity of bearing size throughout the engine

B. Regrind only number 3 to the first undersize because all other journals are within standard specification

C. Replace the crankshaft because the number 3 journal has lost too much material from the failure

D. Regrind only the number 3 main journal to the first undersize (0.010) and install a matching undersize bearing at that position with standard bearings at all other positions

20. A four-cylinder engine that was rebuilt 3,000 miles ago develops a sudden-onset blue exhaust smoke that is visible at all operating conditions. Oil consumption jumps from negligible to one quart per 500 miles within a single week. Compression is still within specification on all cylinders. Oil pressure is normal. The engine does not knock. Which of the following is the MOST likely cause of this sudden-onset oil consumption?

A. Gradual ring wear that has reached a critical threshold and caused a sudden transition from sealed to leaking

B. A cracked piston on one cylinder that suddenly began allowing oil past the ring pack into the combustion chamber

C. A PCV valve that has failed stuck in the full-open position, creating excessive crankcase vacuum that draws oil into the intake

D. Worn valve stem seals on multiple cylinders that have simultaneously reached end-of-life from heat degradation

21. A customer reports that the engine produces a rhythmic ticking noise that is most noticeable when the engine is first started cold but gradually diminishes — though does not completely disappear — as the engine warms to operating temperature. The tick tracks with engine RPM. Oil level is correct. A stethoscope localizes the noise to the valvetrain area on the right bank of a V8 OHV engine. Which of the following is the MOST likely cause?

A. A worn camshaft lobe on the right bank that produces a larger clearance gap when components are cold and contracted

B. A cracked rocker arm that flexes more when cold and stiff but stabilizes somewhat as temperature increases

C. Worn hydraulic lifters on the right bank that take longer to pump up with cold, thick oil at startup and gradually improve as the oil thins but never fully achieve zero lash due to internal wear

D. Hydraulic lifters on the right bank that are slow to fill with cold thick oil but eventually pump up to zero lash as oil warms, thins, and flows more easily through the lifter's internal passages

22. A technician is measuring the cylinder bore on a four-cylinder engine and gets the following measurements on cylinder 2: top perpendicular = 3.5030, top parallel = 3.5025, bottom perpendicular = 3.5018, bottom parallel = 3.5016. The specification maximum taper is 0.002 inches and maximum out-of-round is 0.001 inches. Which of the following is the correct assessment?

A. Taper is 0.0012 inches and out-of-round is 0.0005 inches — both within specification

B. Taper is 0.0014 inches and out-of-round is 0.0005 inches — taper is within specification but the overall bore diameter should be checked against the oversize piston specification

C. Taper is 0.0014 inches and out-of-round is 0.0009 inches — both within specification but borderline

D. Taper is 0.0012 inches and out-of-round is 0.0002 inches — well within specification

23. A rebuilt engine is started for the first time. Oil pressure reaches 50 PSI immediately. The engine sounds smooth. After two minutes, the technician checks the exhaust manifold temperature on each cylinder using an infrared thermometer. Cylinders 1, 2, and 4 read between 350 and 380°F. Cylinder 3 reads 180°F — significantly cooler. Which of the following does the low temperature on cylinder 3 MOST likely indicate?

A. Cylinder 3 has a richer fuel mixture than the others, which cools the exhaust gas temperature at that port

B. Cylinder 3 has higher compression than the other cylinders, which produces more efficient combustion and lower exhaust temperature

C. Cylinder 3 is not firing or is firing very weakly — the low exhaust temperature indicates minimal or no combustion in that cylinder

D. The exhaust manifold runner for cylinder 3 is cracked and allowing ambient air to cool the exhaust gas before it reaches the measurement point

24. Technician A says that when installing new pistons, the directional arrow on the piston crown must always face toward the front of the engine. Technician B says that piston directional markings vary by manufacturer and the technician must verify the correct orientation from the piston manufacturer's documentation. Who is correct?

A. Technician B only

B. Technician A only

C. Both Technician A and Technician B

D. Neither Technician A nor Technician B

25. A vehicle with a known head gasket failure has been driven for approximately 2,000 miles after the customer first noticed overheating symptoms. The customer continued driving by adding coolant regularly. When the engine is finally torn down for repair, which of the following additional damage is MOST likely to have occurred from the extended driving with a breached head gasket?

A. The crankshaft bearings are likely undamaged because the coolant stayed in the cooling system

B. The timing chain has likely stretched from the repeated overheating episodes and needs replacement

C. The camshaft lobes have worn from the overheating cycles and need to be measured during the teardown

D. The cylinder bore on the affected cylinder may be damaged from the abrasive effect of coolant contamination on the ring-to-bore interface and from thermal distortion during repeated overheating events

26. A technician is performing a power balance test on a V8 engine by disabling fuel injectors one at a time and monitoring RPM drop. Disabling cylinders 1 through 7 each produces a 40 to 50 RPM drop. Disabling cylinder 8 produces only a 15 RPM drop. Which of the following does this result indicate about cylinder 8?

A. Cylinder 8 is contributing less power than the other cylinders — it has a mechanical, fuel, or ignition problem that is reducing its combustion effectiveness

B. Cylinder 8 is the strongest cylinder in the engine and produces the least RPM drop when disabled

C. The fuel injector on cylinder 8 has a higher-than-normal flow rate that masks the RPM drop during the test

D. Cylinder 8's position in the firing order produces a naturally smaller RPM drop during the power balance test

27. A customer reports that the engine hesitates for approximately two seconds when the accelerator is pressed after the vehicle has been coasting downhill in gear for more than 15 seconds. The hesitation does not occur during normal stop-and-go driving or during highway passing maneuvers. No codes are stored. All engine mechanical tests are normal. Which of the following is the MOST likely cause?

A. A weak fuel pump that loses prime during the extended deceleration period when fuel demand is zero

B. A sticky throttle plate that hesitates when transitioning from fully closed to open after an extended closure period

C. The PCM's deceleration fuel cut strategy shuts off the injectors during coasting, and the two-second hesitation is the fuel system repressurizing and the PCM transitioning back to open-loop fueling when the accelerator is pressed

D. The exhaust back-pressure builds during the extended deceleration period and momentarily opposes the intake charge when the throttle opens

28. A technician is rebuilding a high-mileage engine and discovers that the oil pump drive gear keyway on the pump shaft has worn into an oval shape. The key fits loosely in the enlarged keyway. The pump itself measures within specification for gear-to-housing and gear-to-cover clearances. Which of the following is the correct action?

A. Install a thicker key to compensate for the worn keyway and continue using the otherwise serviceable pump

B. Replace the oil pump because the worn keyway will allow the drive gear to slip under load, producing intermittent oil pressure drops

C. Apply threadlocker to the key to prevent it from moving in the enlarged keyway during operation

D. Weld the keyway closed and remachine it to the correct dimension to retain the otherwise serviceable pump body

29. A vehicle's engine is running at idle when the technician disconnects the PCV hose from the intake manifold. The idle RPM drops approximately 100 RPM and the engine begins to idle slightly rough. The technician reconnects the hose and the idle smooths and RPM recovers. Which of the following does this test demonstrate?

A. The PCV system is malfunctioning and introducing excessive crankcase gases that disrupt the idle mixture

B. The engine has excessive blowby that is contaminating the intake charge through the PCV system

C. The PCV valve is stuck open and is acting as an uncontrolled vacuum leak on the intake manifold

D. The PCV system is functioning correctly — disconnecting it created a vacuum leak at the open port, and the RPM drop and rough idle are the expected response to losing the PCV's metered airflow

30. A customer brings in a vehicle with 85,000 miles reporting that the engine has gradually lost approximately 10% of its original power. Compression is within specification on all cylinders. Oil pressure is within specification. Vacuum at idle is 17 in. Hg — within normal range. A timing chain measurement shows 3 degrees of camshaft retardation. No misfires or codes are present. Which of the following BEST explains how a 3-degree timing retardation produces a noticeable power loss without dropping compression or vacuum below specification?

A. The 3-degree retardation slightly delays all valve events, reducing the engine's volumetric efficiency at higher RPM where precise timing is most critical for power production — idle vacuum and cranking compression are less affected because they are measured at low RPM where the timing deviation has minimal impact

B. The 3-degree retardation only affects ignition timing, not valve timing, so the power loss has a different cause

C. A 3-degree retardation would improve power by allowing more complete combustion through delayed exhaust opening

D. The power loss cannot be from 3 degrees of retardation because it would require at least 8 degrees to produce a noticeable symptom

31. A technician is inspecting a flywheel removed during a clutch replacement. The friction surface has a slight blue discoloration in a crescent-shaped pattern covering approximately one-quarter of the surface area. The rest of the surface appears normal. There is no warpage, no cracking, and no hard spots detected with a hardness tester. Which of the following is the correct action?

A. Replace the flywheel because uneven heat discoloration indicates uneven clamping force distribution

B. Resurface the flywheel to remove the discolored layer and restore a uniform friction surface

C. Reinstall the flywheel as-is because partial discoloration without hardness changes is cosmetic

D. Replace the flywheel because the crescent pattern indicates the flywheel has developed runout from heat

32. A rebuilt engine has been running for 500 miles. The first oil change is being performed. The technician cuts open the oil filter and finds a moderate amount of fine gray metallic particles on the filter media — more than expected for a normal break-in. The oil on the dipstick has a slight silver shimmer. Oil pressure is within specification. The engine sounds normal. Which of the following is the MOST appropriate action?

A. Change the oil and filter, shorten the next oil change interval to 500 miles, and recheck the filter at that service to determine if particle generation is decreasing or increasing

B. Immediately disassemble the engine because the metallic particle volume indicates a bearing failure in progress

C. Continue with the standard 3,000-mile oil change interval because some metallic particles are expected during break-in

D. Send an oil sample to a laboratory for analysis and continue driving until the results are available

33. A customer's engine has been diagnosed with a cracked exhaust manifold on a V6 engine. The crack is approximately 3 inches long and runs along the manifold between the number 2 and number 3 runners. The customer asks if the crack can be welded. The manifold is cast iron. Which of the following is the correct response?

A. Cast iron exhaust manifolds can be welded easily with a standard MIG welder and a stainless steel wire

B. Cast iron manifold cracks can be brazed with a nickel-bronze rod for a permanent repair at lower cost than replacement

C. The crack can be welded by a specialist using the correct cast iron welding procedure, but the repair may not last as long as a replacement manifold

D. Cast iron exhaust manifold welding is a reliable, permanent repair that is preferred over replacement in all circumstances

34. A technician is performing an exhaust manifold bolt removal on a cast iron exhaust manifold attached to an aluminum cylinder head. Three of the six bolts break during removal despite applying

penetrating oil and allowing 30 minutes of soak time. The broken bolts are flush with the head surface. Which of the following extraction method should the technician attempt FIRST?

A. Apply direct heat to each broken bolt with an oxy-acetylene torch to expand the bolt and break the corrosion bond

B. Weld a nut onto each broken bolt stub to provide a wrench surface for extraction by turning

C. Center-drill each broken bolt, then use a left-hand drill bit that may unscrew the bolt during drilling, followed by an EZ-Out extractor if the drilling does not remove the bolt

D. Drill through each broken bolt with a standard right-hand drill bit and install a thread insert in each hole

35. A vehicle owner reports that the engine temperature gauge drops below the normal midpoint position during sustained highway driving at 65 mph in 30°F weather. The heater output becomes noticeably cooler during this period. The temperature returns to normal during city driving. The vehicle has 50,000 miles. Which of the following is the MOST likely cause?

A. The radiator is oversized for the vehicle application and rejects too much heat during cold highway driving

B. The thermostat is opening at a lower temperature than its rated specification, allowing premature coolant flow to the radiator under the high-airflow conditions of highway driving in cold weather

C. The lower grille air dam has been removed or damaged, allowing excessive cold air to reach the radiator

D. The water pump impeller is circulating coolant too rapidly at highway RPM, preventing the coolant from absorbing adequate heat in the engine

36. A technician is diagnosing an engine with a rough idle and a vacuum reading of 13 in. Hg at sea level — below the normal 17 to 21 in. Hg range. Compression is uniformly low at 115 to 122 PSI on all four cylinders (specification 145 to 160). A wet test improves all cylinders by 25 to 30 PSI. A timing measurement shows the cam timing is correct. The PCV system is functional. Which of the following BEST explains the low vacuum despite correct cam timing?

A. A significant exhaust restriction is preventing the cylinders from fully evacuating and reducing the vacuum generated during the intake stroke

B. The intake manifold has a very large vacuum leak that is reducing the manifold vacuum measurement

C. The engine has advanced ignition timing that is reducing the effective intake stroke vacuum

D. The severely worn piston rings (confirmed by the wet test improvement) allow so much compression leakage past the rings that each cylinder's reduced sealing capacity directly reduces the vacuum the engine can develop

37. A rebuilt engine has been running for 10,000 miles. The customer brings the vehicle in for a routine oil change. The technician tests oil pressure: hot idle = 22 PSI (specification minimum 15), hot 2,500 RPM = 46 PSI (specification 40 to 65). At the 500-mile break-in service, the readings were 32 PSI at idle and 58 PSI at speed. Which of the following BEST characterizes the pressure trend?

A. The pressure has decreased from break-in values but all readings remain within specification, indicating normal bearing wear-in that is stabilizing after the initial break-in period

B. The 10 PSI idle drop in 10,000 miles is excessive and indicates premature bearing failure

C. The speed pressure dropping from 58 to 46 PSI indicates the oil pump is wearing prematurely

D. The pressure trend indicates the engine was assembled with clearances that are too loose

38. A customer reports that the engine makes a brief metallic scraping sound the first time the key is turned to the Start position each morning. The sound lasts less than one second and does not occur on subsequent starts during the day. The starter was replaced four months ago. Which of the following is the MOST likely cause?

A. The ring gear has a worn section at the position where the engine stops each night, and the starter pinion grinds on the worn teeth before engaging fully

B. The starter pinion is not fully retracting into the starter housing after the previous day's last start, and the first morning engagement produces a brief grind as the pinion re-engages from its extended position

C. The flywheel has excessive runout that causes interference with the starter pinion at one specific rotational position

D. The starter solenoid requires more voltage to engage the pinion in cold temperatures, causing a delayed engagement that produces the scraping sound

39. A technician discovers during an engine rebuild that the block has been previously align-bored. The main bearing bore diameters are 0.010 inches larger than the standard specification. Standard bearings are installed and Plastigage clearance checks show the bearing clearances are within specification with the standard-size bearings. Which of the following is the correct interpretation?

A. Standard bearings cannot be used in an align-bored block and the clearance reading must be incorrect

B. The align boring process enlarged the bores, so the Plastigage must be reading incorrectly — oversize bearings are required

C. The bearings used are standard wall thickness and the correct clearance was achieved because the crankshaft journals are also at a corresponding specification that produces the designed clearance in the enlarged bores

D. The Plastigage clearance checks confirm that standard bearings properly fill the enlarged bores — this occurs because align boring removes material from the cap mating surfaces and then rebores to a larger finished diameter, and the correct bearing selection for an align-bored block is thicker (0.005 per half) to restore the designed clearance

40. A customer reports that the engine oil level on the dipstick has gradually risen from the full mark to approximately three-quarters of a quart above full over the past month. The oil does not smell like fuel. The oil has a very slight grayish tint but no milky appearance. The coolant level in the overflow tank has dropped by approximately the same amount. Oil pressure and compression are within specification. Which of the following is the MOST likely cause?

A. A head gasket failure between a combustion chamber and an oil passage that is pushing combustion gas into the oil and aerating it

B. An internal transmission cooler line failure that is allowing transmission fluid to enter the cooling system

C. Excessive crankcase condensation from cold-weather short-trip driving that is accumulating in the oil pan

D. A failed internal barrier in the engine oil cooler that is allowing coolant to cross into the oil under the cooling system's higher operating pressure

41. A technician is performing a leak-down test on a V8 engine and gets the following results: cylinders 1 through 6 show 5% to 10% leakage with faint air at the oil filler only. Cylinder 7 shows 8% leakage with faint air at the oil filler. Cylinder 8 shows 28% leakage with air heard at the intake manifold only — not at the tailpipe, oil filler, or coolant. Which of the following is the MOST likely cause of cylinder 8's specific leak pattern?

A. A head gasket breach between cylinder 8's combustion chamber and the adjacent intake port in the gasket

B. A burned exhaust valve on cylinder 8 that is leaking compression into the exhaust and then back-flowing to the intake through valve overlap

C. An intake valve on cylinder 8 that is not sealing properly — burned, bent, or held open by a deposit — allowing air to pass from the combustion chamber through the intake port to the manifold

D. A cracked intake manifold runner above cylinder 8 that is allowing the leak-down air to escape

42. A rebuilt engine is being pre-primed with a drill-driven priming tool before the first start. The technician observes that oil pressure builds to 30 PSI within 10 seconds and holds steady. However, when the technician checks under the valve covers, oil is flowing to seven of eight rocker arm assemblies — one rocker arm area is completely dry despite two minutes of priming. Which of the following is the MOST likely cause?

A. The oil gallery passage feeding that specific rocker arm or lifter bore is blocked with debris or dried sealant from the assembly process

B. The hydraulic lifter at that position has a defective check valve that is preventing oil from passing through

C. The pushrod at that position is not properly seated in the lifter cup and is blocking the oil path through the pushrod

D. The rocker arm pivot at that position has an oil passage that was not drilled at the factory

43. A customer brings in a vehicle where the engine has been running with the oil level two quarts above the full mark. The customer accidentally added two extra quarts during a DIY oil change and has been driving for 500 miles. The engine has developed a noticeable increase in crankcase pressure — the oil filler cap hisses slightly when opened. Which of the following BEST explains the increased crankcase pressure?

A. The excess oil is foaming from crankshaft counterweight contact, and the aerated oil increases the crankcase volume of gas-filled liquid that the PCV system cannot adequately vent

B. The excess oil has damaged the PCV valve by flooding it with oil and preventing it from opening fully

C. The overfilled oil has reached the bottom of the cylinders and is being burned, producing extra combustion byproducts in the crankcase

D. The crankshaft counterweights are contacting the excess oil and whipping it into a foam, which increases the effective crankcase gas volume beyond what the PCV system was designed to vent

44. A technician is diagnosing an engine that runs perfectly at all conditions except during a specific deceleration scenario: when the driver lifts off the throttle at exactly 3,000 RPM in third gear, the engine produces a brief shudder. The shudder does not occur at any other RPM, in any other gear, or during acceleration. Compression, vacuum, and all mechanical tests are normal. Which of the following is the MOST likely cause?

A. A worn crankshaft harmonic balancer that allows torsional vibration to pass through at the specific resonant frequency created by that RPM and drivetrain load combination

B. A specific drivetrain resonance — the combination of that exact RPM, gear ratio, and deceleration load creates a torsional vibration that passes through the engine and driveline, producing the shudder

C. A worn engine mount that allows the engine to shift at the specific torque reversal point of deceleration in third gear

D. A timing chain that develops momentary slack at the precise RPM of 3,000 during the low-tension conditions of deceleration

45. A technician discovers during an engine rebuild that the number 3 main bearing cap has a small chip on its mating surface — approximately 2 mm wide and 0.5 mm deep — at the edge of the bore. The chip appears to be from a tool impact during the previous engine teardown. Which of the following is the correct action?

A. Dress the chip smooth with a fine file and install the cap — the chip is outside the bearing bore contact area and will not affect bore roundness

B. Stone the cap mating surface flat to remove the chip and restore the mating surface before installation

C. Replace the main bearing cap because any mating surface damage compromises the bore geometry

D. Install the cap with a thin layer of gasket sealant over the chipped area to restore the sealing surface

46. A customer reports that the engine produces a very faint ticking noise at idle that completely disappears above 1,200 RPM. The noise has been present for 30,000 miles and has not changed in character or volume. Oil pressure is within specification at all conditions. Compression is within specification on all cylinders. The customer asks if the engine is in danger of failing. Which of the following is the MOST accurate response?

A. A stable, unchanging, faint tick at idle that disappears at speed, with normal oil pressure and compression, is most likely a minor valvetrain characteristic that does not indicate an impending failure

B. Any valvetrain ticking indicates a developing lifter or cam lobe failure that will eventually require repair

C. The ticking will inevitably worsen and the customer should budget for a top-end rebuild within 10,000 miles

D. The tick indicates a rod bearing problem that is only audible at idle and requires immediate attention

47. A four-cylinder engine has the following compression results after a head gasket replacement: Cyl 1 = 155, Cyl 2 = 152, Cyl 3 = 155, Cyl 4 = 110 PSI. All cylinders were above 145 PSI before the gasket failure. The cylinder 4 wet test shows improvement to 118 PSI. A leak-down test on cylinder 4 shows 25% leakage with air heard at the exhaust tailpipe only. Which of the following MOST likely occurred during the head gasket repair?

A. The head gasket was installed incorrectly and is leaking on cylinder 4 specifically

B. During the head removal or reinstallation, the number 4 exhaust valve was damaged — likely bent from a piston contact event if the crankshaft or camshaft was rotated improperly with the head partially installed

C. The number 4 spark plug was installed cross-threaded and is leaking compression past the plug threads

D. Carbon debris fell into cylinder 4 during the repair and is now preventing the exhaust valve from fully seating

48. A technician is diagnosing a V6 engine that has a slow but consistent coolant loss — approximately one pint every two weeks. There are no external leaks, no white smoke, no oil contamination, and block tests at both idle and 2,500 RPM are negative. A UV dye has been in the coolant for 300 miles and no fluorescence has been found anywhere on the engine, exhaust, or ground. Which of the following remaining diagnostic approaches is MOST likely to identify the source?

A. Replace the head gaskets preemptively because all other tests have been exhausted

B. Perform an extended pressure test overnight with a calibrated digital gauge to detect a pressure drop too small for the standard 20-minute test

C. Test for combustion gas in the coolant using a more sensitive mass spectrometer method rather than the standard block test chemical

D. Perform a leak-down test on each cylinder individually while monitoring the coolant level for any drop during each cylinder's test — this identifies which specific cylinder's leak-down pressure reaches the coolant

49. Technician A says that when installing a harmonic balancer on a crankshaft, the balancer should be tapped onto the snout with a hammer and a block of wood to seat it against the crankshaft shoulder. Technician B says that the harmonic balancer should be drawn onto the snout using the installation bolt and a thick washer to apply even, controlled force. Who is correct?

A. Technician B only

B. Technician A only

C. Both Technician A and Technician B

D. Neither Technician A nor Technician B

50. A rebuilt engine has been through its break-in procedure and the customer has been driving the vehicle for 5,000 miles. All quality checks at 500 miles were satisfactory. The customer now reports that the engine has developed a faint but consistent exhaust odor inside the cabin when driving with the windows closed and the HVAC on fresh air mode. No exhaust leak is visible or audible under the vehicle. The engine runs perfectly with no performance issues. Which of the following should the technician investigate?

A. The head gasket for a minor exhaust-to-coolant breach that is introducing exhaust gas into the heater core

B. The PCV system for a malfunction that is pressurizing the crankcase and pushing exhaust byproducts into the cabin through the HVAC fresh air intake

C. A small exhaust leak at a gasket or connection point that is too small to see or hear but allows exhaust to migrate to the HVAC fresh air intake location near the base of the windshield

D. The catalytic converter for a failure that is producing an exhaust odor different from the normal tailpipe emission

Practice Exam 17: 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. B — Cylinder 5 has two minor mechanical deficiencies confirmed by the leak-down: slight ring bypass (faint air at oil filler) and a marginally leaking exhaust valve (faint air at tailpipe), with compression exactly at the minimum specification. [A] Light-throttle cruise between 35 and 45 mph produces the lowest cylinder charge volumes and combustion pressures of any driving condition — less charge than idle (where the closed throttle creates high vacuum that draws a full charge at low pressure) and far less than WOT. This narrow operating window is where the combined leakage produces just enough compression loss to cross the misfire threshold.

2. D — The engine has fuel pressure (58 PSI), spark (confirmed on all cylinders), and compression (148–155 PSI) — the three fundamental requirements for starting are present at the system level. [E] However, fuel pressure in the rail does not confirm the injectors are actually pulsing fuel into the cylinders. If the PCM is not sending the injector pulse signal — from a failed crankshaft position sensor, a broken timing signal, or a PCM power/ground fault — the injectors remain closed despite the rail being pressurized. Checking for injector pulse with a noid light is the logical next step.

3. A — Oil pressure that is rock-steady when cold but oscillates 6 PSI at hot idle points to a condition that manifests only when oil viscosity drops to its thinnest operating state. [D] The oil pickup tube O-ring is the most likely culprit: when cold, the thick oil maintains a strong suction seal at the pickup despite a marginal O-ring. When the oil thins at operating temperature, the reduced viscosity weakens the suction seal enough for the marginal O-ring to intermittently break seal and admit air, causing the pump output to pulse as it alternately draws oil and air.

4. C — The corrected clearance of 0.010 inches falls at the minimum of the 0.010 to 0.012 inch specification — it is within the acceptable range. [B] While it is at the lower boundary rather than the middle, the valve will operate correctly. The exhaust valve will close fully with adequate clearance to allow for thermal expansion. As the engine accumulates mileage and the valve seat wears slightly, the clearance will increase toward the middle of the specification naturally.

5. B — The greenish stain on the block deck surface near the gasket breach is coolant residue — the characteristic color of ethylene glycol-based coolant that has been forced against the metal surface under the extreme pressure of combustion gas pushing through the gasket breach. [A] During each power stroke, combustion pressure (600+ PSI) forces through the breach into the coolant passage, and the pressurized coolant contacts the block deck surface around the breach area. Over weeks of driving, the coolant deposits its dye and additive compounds on the metal surface, leaving the telltale green stain.

6. D — Technician A is correct about converter temperatures and the risk of substrate damage from raw fuel — catalytic converters routinely operate above 1,200°F and can exceed 1,400°F under load, and unburned fuel from a misfiring cylinder can raise internal temperatures high enough to melt the ceramic substrate. [E] Technician B's statement is incorrect as stated: a glowing red converter housing does not always mean the converter has failed — it more commonly indicates the converter is being overwhelmed by raw fuel from an upstream misfire. The converter itself may be functioning perfectly but is simply processing more fuel than it was designed to handle.

7. A — All four symptoms — uniformly low compression, low vacuum, power loss, and poor fuel economy — are explained by a single root cause: the 8-degree camshaft retardation from timing chain stretch. [A] When the chain stretches and retards the camshaft, the intake valve closes late in the compression stroke, allowing a portion of the intake charge to escape back through the still-open valve before compression can build fully. This reduces effective compression ratio, lowers vacuum, decreases power output, and forces the driver to open the throttle further (burning more fuel) to maintain speed.

8. C — A small dent on the piston crown (3 mm diameter, 0.5 mm deep) caused by a foreign object, with no radiating cracks, does not compromise the piston's structural integrity. [C] The crown material is thick enough that this shallow dent does not create a stress concentration capable of propagating a crack under normal combustion loads. The slight volume change is negligible relative to the total combustion chamber volume. The piston can be installed as-is without concern for functional or durability issues.

9. B — The engine nearly stalls only when three specific loads are applied simultaneously: A/C compressor parasitic drag, torque converter load in Drive, and brake booster vacuum demand from a firmly pressed pedal. [A] Each load individually is manageable at idle, but the combination exceeds the engine's idle reserve capacity — the margin between the idle airflow and the minimum airflow needed to sustain combustion. The idle control system cannot open the throttle far enough or fast enough to compensate for all three simultaneous loads. This is a system capacity issue, not a mechanical failure.

10. D — A crankshaft with a welded counterweight — regardless of how professional the repair appears and regardless of passing Magnaflux — has been metallurgically compromised. [C] Welding introduces a heat-affected zone around the repair that alters the grain structure of the parent metal, creating areas

with different hardness, ductility, and fatigue resistance than the original forged or cast material. Under the millions of cyclic stress reversals a crankshaft endures during normal operation, the heat-affected zone becomes a preferential site for fatigue crack initiation. The crankshaft must be replaced.

11. A — Air leaking simultaneously from both the intake and exhaust on a single cylinder — with no air at the oil filler or coolant — means both the intake and exhaust valves are partially open at what should be TDC compression. [A] The only condition that opens both valves simultaneously during the compression stroke is incorrect camshaft timing — if the timing has jumped significantly, the valve events are displaced far enough that both valves are in the overlap position when the piston reaches TDC compression. The minimal wet test improvement (60 to 65) confirms the rings are not the issue.

12. C — A negative block test at both idle and elevated RPM may miss a very small head gasket breach because the volume of combustion gas entering the coolant is below the chemical test's detection threshold. [A] A more sensitive approach is to pressurize the cooling system and then perform a leak-down test on each cylinder individually — if coolant level drops when a specific cylinder is pressurized, that cylinder's combustion chamber is connected to the coolant through a breach. This test applies higher pressure (typically 80–100 PSI) than combustion at idle and directly correlates the leak to a specific cylinder.

13. B — A vibration at a specific RPM (2,200) that disappears above and below that speed, appeared after a rebuild, and is present with no misfires or mount issues, points to a torsional resonance that is no longer being dampened. [A] The harmonic balancer absorbs torsional vibrations at the crankshaft's natural resonant frequencies. If the balancer was damaged during removal, replaced with an incorrect unit, or its rubber element was compromised during the rebuild, it can no longer dampen the specific resonant frequency at 2,200 RPM. The vibration is absent at other speeds because the crankshaft's torsional excitation frequency does not match the resonance at those RPMs.

14. D — The upper one-third of each bore showing polished surfaces with faint vertical scoring — while the lower two-thirds shows normal wear — is the pattern of piston scuffing from thermal expansion during a severe overheating event. [C] When the engine overheated, the aluminum pistons expanded beyond their designed clearance. The expanded piston skirts contacted the upper bore walls (where clearance is naturally tightest due to the hotter environment near the combustion chamber) and metal-to-metal contact polished away the crosshatch and produced the vertical score marks.

15. A — An occasional cold-start intake backfire (once per week) on a DOHC engine with VVT, with no codes and normal operation afterward, is consistent with a VVT cam phaser that intermittently drains oil during sitting periods and rests in an incorrect angular position. [A] On the next start, if the intake camshaft is slightly advanced or retarded from its correct start position, the intake valve may be partially

open during the compression stroke on one cylinder. The compressed charge pushes back through the open valve into the intake manifold, producing the backfire. Oil pressure refills the phaser within the first second of cranking, correcting the timing.

16. C — A Plastigage strip that is widest at the center and narrowest at the edges indicates the journal has an hourglass (concave) profile — the center diameter is smaller than the edges. [C] The Plastigage is compressed more where the clearance is tighter (at the edges where the journal is larger) and compressed less where the clearance is wider (at the center where the journal is smaller). This wear pattern — the center wearing more than the ends — occurs from the bending load the connecting rod applies to the journal during each power stroke. The journal should be reground to restore a uniform cylindrical profile.

17. B — A whistling noise that increases with boost pressure, with no boost leaks and no turbo shaft play, points to damage on the compressor wheel that disrupts smooth airflow at high speed. [E] A chipped, cracked, or bent compressor blade causes turbulent airflow at the damaged blade's location. At low speed (idle and naturally aspirated operation), the turbulence is insufficient to produce audible noise. Under boost, the compressor wheel spins at 100,000+ RPM and the damaged blade produces a high-frequency whistle as it disrupts the compressed airstream with each revolution.

18. A — A slight gasoline odor in the oil at the full mark (not elevated), with no misfires, no codes, and a driving pattern of frequent short trips in cold weather, is the classic presentation of fuel condensation from incomplete combustion during cold operation. [E] During cold starts and short trips, the rich cold-start fuel mixture does not burn completely, and a small amount of unburned fuel washes past the rings into the crankcase. On a fully warmed engine driven for sustained periods, the oil temperature rises enough to evaporate the fuel through the PCV system. Short cold-weather trips prevent this evaporation.

19. D — Only the number 3 main journal is damaged; all others are within standard specification. [C] The standard practice for a single damaged journal is to regrind only that journal to the first undersize (0.010 under) that cleans up the scoring and heat damage, and install a matching undersize bearing at that position. All other main bearings remain standard size. Each main bearing position is an independent lubrication system, so mixing undersize and standard bearings at different positions is an accepted and common repair practice.

20. C — A sudden transition from negligible oil consumption to one quart per 500 miles within a single week — with normal compression, normal oil pressure, and no knocking — points to a discrete failure event rather than gradual wear. [A] A PCV valve stuck in the full-open position creates excessive vacuum in the crankcase that actively draws liquid oil and oil vapor into the intake manifold at all

operating conditions. This abrupt onset matches a sudden valve failure, not the progressive worsening of ring or seal wear. The catalytic converter may be masking the visible smoke.

21. D — A valvetrain tick that is loudest at cold start and gradually diminishes (but in this case, does not completely disappear) as the engine warms is consistent with hydraulic lifters that are slow to fill with cold, thick oil. [B] Cold oil has higher viscosity and flows more slowly through the lifter's small internal passages and check valve. As the oil warms and thins, it flows more easily into the lifters, and most of them achieve zero lash — hence the gradual improvement. The persistent residual tick on one or two lifters suggests those specific units have slightly worn internal components that prevent complete zero-lash achievement even when warm.

22. B — Taper is calculated from the largest to smallest measurement in the same direction: perpendicular = 3.5030 minus 3.5018 = 0.0012; parallel = 3.5025 minus 3.5016 = 0.0009. Maximum taper = 0.0012. [C] Out-of-round at top = 3.5030 minus 3.5025 = 0.0005; at bottom = 3.5018 minus 3.5016 = 0.0002. Maximum out-of-round = 0.0005. Both are within specification (taper under 0.002, out-of-round under 0.001). However, the bore diameter of 3.5030 should be verified against the piston specification to ensure the correct piston-to-bore clearance.

23. C — An exhaust manifold port that reads 180°F while all others read 350 to 380°F on a freshly started rebuilt engine indicates cylinder 3 is not producing significant combustion — the low temperature means very little or no hot combustion gas is exiting that port. [A] The most likely causes are a disconnected spark plug wire, an unplugged injector connector, a fouled plug, or a compression failure on that cylinder. The technician should immediately investigate why cylinder 3 is not contributing — continuing to run an engine with one dead cylinder during break-in risks camshaft and ring seating problems.

24. A — Technician B only is correct: piston directional markings vary between manufacturers — some specify the arrow toward the front of the engine, others toward the exhaust, and others use different conventions entirely. [C] Technician A's blanket statement that the arrow "must always face toward the front" is incorrect because it does not account for manufacturer-specific variations. The only reliable method is to consult the piston manufacturer's documentation or the engine builder's reference for the specific piston being installed.

25. D — Extended driving with a head gasket breach exposes the affected cylinder's bore to coolant contamination and repeated overheating — both of which damage the ring-to-bore interface. [A] Coolant entering the combustion chamber washes lubricating oil from the cylinder wall, and the anti-freeze additives create an abrasive slurry that accelerates ring and bore wear. Repeated overheating

causes thermal distortion of the bore, piston, and rings that further compromises the seal. The affected cylinder may require boring and oversized pistons during the repair.

26. A — A cylinder that produces only a 15 RPM drop when disabled — compared to 40 to 50 RPM on all other cylinders — is contributing significantly less power to the engine's total output. [A] When a strong cylinder is disabled, the engine loses a substantial portion of its power output and RPM drops noticeably. When a weak cylinder is disabled, the engine loses less power because that cylinder was not contributing much to begin with. The small RPM drop on cylinder 8 confirms it has a mechanical, fuel, or ignition deficiency that is reducing its combustion effectiveness.

27. C — The two-second hesitation following extended closed-throttle coasting is caused by the PCM's deceleration fuel cut-off (DFCO) strategy. [E] During coasting in gear, the PCM shuts off the fuel injectors to save fuel and reduce emissions. When the driver presses the accelerator, the fuel system must transition from zero delivery back to the appropriate fueling level. This transition requires the pump to repressurize the rail, the injectors to resume pulsing, and the PCM to recalculate the appropriate fuel delivery — a process that takes approximately one to two seconds.

28. B — An oil pump with a worn, oval-shaped keyway on the drive gear will allow the drive gear to slip on the shaft under the torsional loading of normal operation. [D] When the key shifts in the enlarged keyway, the pump momentarily loses its drive connection, and oil pressure drops until the key re-engages. This produces intermittent, unpredictable oil pressure fluctuations that can starve bearings during the momentary pressure loss. A thicker key or threadlocker are unreliable fixes — the pump must be replaced.

29. D — Disconnecting the PCV hose from the intake manifold creates an open port that admits unmetered air — a vacuum leak. [A] The 100 RPM drop and slight rough idle are the expected responses to this sudden unmetered air introduction. When the hose is reconnected, the PCV valve resumes its designed function of metering the crankcase ventilation flow, the vacuum leak is sealed, and the idle stabilizes. This test demonstrates the PCV system is working correctly — the response confirms the system is connected and the intake manifold is responding normally to changes in airflow.

30. A — A 3-degree camshaft retardation from chain stretch reduces the engine's volumetric efficiency — the ability to fill and empty each cylinder completely — primarily at higher RPM where precise valve timing is most critical. [A] At idle and during cranking compression tests, the engine operates at low RPM where the relatively slow gas velocity and long cycle time minimize the impact of a few degrees of timing error. At higher RPM, where the gas must move quickly through the ports during a very brief valve opening window, even 3 degrees of retardation reduces the effective charge trapped in each cylinder, producing the noticeable power loss.

31. B — A flywheel with crescent-shaped partial discoloration — covering only one-quarter of the friction surface — without warpage, cracking, or hardness changes, has localized heat damage that affects the uniformity of the friction surface. [C] While the metal hardness has not changed (confirmed by testing), the discolored area has a different surface texture and thermal history than the rest. Resurfacing removes the heat-affected layer uniformly across the entire surface, restoring a consistent friction surface for the new clutch disc.

32. A — A moderate quantity of metallic particles at the 500-mile break-in oil change — more than the typically expected fine dusting — warrants heightened monitoring rather than immediate teardown or dismissal. [D] The appropriate response is to change the oil and filter, shorten the next interval to 500 miles, and cut open the filter at that service. If the particle quantity has decreased, the break-in is progressing normally and the initial excess was from aggressive ring seating. If the quantity has increased or stayed the same, more aggressive investigation (oil analysis, pressure test, teardown) is warranted.

33. C — Cast iron exhaust manifold welding can be performed by a specialist using the correct techniques — proper preheating, correct filler rod (usually nickel-based), controlled cooling to prevent cracking — and can produce a functional repair. [E] However, the technician should advise the customer that cast iron welding in a high-thermal-stress application like an exhaust manifold is inherently less reliable than a new or remanufactured replacement. The weld zone has different metallurgical properties than the parent casting and may re-crack under the extreme thermal cycling of exhaust manifold operation.

34. C — Center-drilling the broken bolt followed by a left-hand drill bit is the standard first-attempt extraction method for broken exhaust studs. [B] The left-hand bit cuts counterclockwise, and its cutting action often catches the remaining stud body and unscrews it as the bit advances — removing the stud without needing a separate extractor. If the stud does not unscrew during drilling, the drilled hole accepts an EZ-Out screw extractor that applies controlled counterclockwise turning force. This sequential approach maximizes success while minimizing the risk of further head damage.

35. B — An engine that overcools during sustained highway driving in cold weather — with reduced heater output and a gauge dropping below normal — has a thermostat allowing coolant to reach the radiator before the engine has fully warmed or when the engine cannot maintain temperature against the cooling capacity. [D] A thermostat opening at a lower temperature than its rated specification allows premature coolant flow to the radiator. At 65 mph in 30°F weather, the massive ram airflow through the radiator removes heat faster than the engine generates it at cruise load, overcooling the engine. A correctly rated thermostat would hold the coolant in the engine until the proper temperature.

36. D — The vacuum gauge reads 13 in. Hg despite correct cam timing — meaning the low vacuum is not from retarded valve timing. [A] The wet test improvement of 25 to 30 PSI on all cylinders confirms severe ring wear. Worn rings allow significant blowby on every compression and power stroke — compressed gas that should drive the piston escapes past the rings into the crankcase. This blowby directly reduces the effective sealing of each cylinder during the intake stroke, reducing the vacuum the engine can develop. The more worn the rings, the lower the vacuum, even with correct valve timing.

37. A — Oil pressure readings that have decreased from break-in values (32 to 22 at idle, 58 to 46 at speed) but remain within specification at both measurement points indicate the engine is experiencing the expected post-break-in bearing wear-in process. [D] New bearings undergo a controlled micro-wear process during the first 5,000 to 10,000 miles where the soft overlay material conforms to the journal surface. This process slightly increases clearances, and the rate of pressure decrease decelerates as the surfaces reach their equilibrium running condition. All readings remaining within specification confirms normal operation.

38. B — A brief metallic scraping sound only on the first morning start that does not recur during the day — even after hours of sitting — indicates a condition specific to overnight sitting. [E] The starter drive mechanism may not be fully retracting into the housing after the last start of the day. Over the longer overnight period, the drive settles into a partially extended position where the pinion teeth partially mesh with the ring gear. On the first morning engagement, the rotating pinion briefly grinds against the partially meshed ring gear before fully engaging. Shorter daytime sitting periods do not allow the drive to settle.

39. C — Align boring enlarges the main bearing bores, but the Plastigage clearance checks show correct clearance with what appear to be standard bearings. [C] The most likely explanation is that the crankshaft journals have been previously reground to a corresponding undersize — or the "standard" bearings being used are actually the correct thicker (0.005-per-half oversize) bearings that match the enlarged bores but are marked as "standard" for the align-bored application. The Plastigage confirms the actual installed clearance is correct regardless of the bearing marking.

40. D — An oil level that rises by the same volume that the coolant drops — with no fuel odor and a slight grayish tint — is the signature of coolant crossing into the oil through an internal barrier failure. [D] The liquid-cooled engine oil cooler operates with coolant at approximately 16 PSI on one side and oil at near-atmospheric pressure on the other. When the internal barrier fails, coolant crosses into the lower-pressure oil side. The slight gray tint is the early stage of coolant mixing with oil — not yet milky because the contamination volume is still relatively small.

41. C — Air leaking exclusively from the intake manifold on cylinder 8 — with no air at the tailpipe, oil filler, or coolant — confirms the sole leak path is through the intake valve into the intake port and manifold. [B] The intake valve on cylinder 8 is not sealing — either burned, bent, or held open by a carbon deposit or mechanical obstruction. The absence of air at any other location confirms no other leak paths exist. The 28% leakage represents a significant valve sealing failure that requires cylinder head removal for inspection and repair.

42. A — Seven of eight rocker arm positions receiving oil during pre-priming while one remains completely dry — despite two minutes of continuous priming — indicates a complete blockage in the oil delivery path to that specific position. [D] The most likely cause is debris or dried sealant in the oil gallery passage feeding that lifter bore or rocker arm. During assembly, gasket sealant, thread sealant, or cleaning debris can enter and block a gallery passage. The blockage must be cleared before the engine is started — running without oil to that lifter and rocker arm will destroy the cam lobe within minutes.

43. D — When the oil level is two quarts above the full mark, the crankshaft counterweights dip into the oil surface and whip it into a foam at every revolution. [D] The aerated, foamy oil occupies more volume than liquid oil, increasing the effective crankcase gas volume. The PCV system is designed to vent a specific volume of crankcase gases per minute — when the foam increases the gas volume beyond this capacity, crankcase pressure rises. The solution is to drain the excess oil to restore the correct level.

44. B — A shudder that occurs only at exactly 3,000 RPM, only in third gear, and only during deceleration is a drivetrain resonance — a specific combination of engine RPM, gear ratio, driveshaft speed, and the torque reversal of deceleration that excites a torsional vibration in the drivetrain. [A] This type of condition-specific vibration is not an engine mechanical problem — it is a resonance phenomenon where the frequencies of multiple rotating components align to amplify a vibration. Changing any one variable (RPM, gear, load direction) breaks the resonance and the shudder disappears.

45. B — A main bearing cap mating surface with a small chip from tool impact can affect the bore geometry when the cap is torqued. [C] The chip prevents the cap from seating fully flush against the block saddle at the chipped location. Stoning the cap's mating surface flat with a fine-grit stone removes the raised edges and restores the flat contact surface needed for proper bore geometry when torqued. This is a standard reconditioning step that preserves the cap without requiring replacement.

46. A — A faint, stable, unchanging tick at idle that disappears above 1,200 RPM — present for 30,000 miles without progression and accompanied by normal oil pressure and compression — is most likely a minor valvetrain characteristic rather than a developing failure. [A] Many engines produce slight valvetrain noise at idle from normal manufacturing tolerances in the lifter, rocker arm, or cam follower

interface. The key diagnostic indicator is stability — a noise that does not change in 30,000 miles is not progressing toward failure. The customer can be reassured that monitoring is appropriate but immediate repair is not indicated.

47. B — Low compression on cylinder 4 (110 PSI) after a head gasket repair that was not present before, with air at the tailpipe only on leak-down and minimal wet test improvement, confirms exhaust valve damage on cylinder 4. [B] The most likely cause is that during the head removal or reinstallation, the crankshaft or camshaft was rotated while the head was partially installed — or the timing was disturbed — causing a piston to contact and bend the number 4 exhaust valve. The bent valve cannot seat against its seat, leaking compression directly to the exhaust.

48. D — Standard block tests, UV dye tests, and pressure tests have all been performed without detecting the coolant loss source. [A] A leak-down test performed on each cylinder individually while monitoring the coolant level applies significantly higher pressure (80–100 PSI) directly to each combustion chamber — much higher than the 16 PSI of a cooling system pressure test. If pressurizing a specific cylinder causes the coolant level to drop, that cylinder's combustion chamber communicates with the coolant through a breach too small for other tests to detect.

49. A — Technician B only is correct: the harmonic balancer should be drawn onto the crankshaft snout using the installation bolt and a thick washer (or a dedicated installation tool) to apply controlled, even force along the axis of the crankshaft. [C] Technician A's method — hammering on the balancer with a block of wood — transmits shock loads through the crankshaft that can damage thrust bearings, main bearings, and the rear pilot bearing. The impact can also crack the balancer's rubber bonding layer. Controlled, steady force from the installation bolt seats the balancer without shock loading.

50. C — An exhaust odor inside the cabin through the HVAC fresh air intake on a vehicle with no visible or audible exhaust leak, and no performance issues, points to a very small exhaust leak at a gasket or connection point that is below the threshold of visual or audible detection. [E] The HVAC fresh air intake is typically located at the base of the windshield — directly above the engine compartment. A small exhaust leak in the engine bay area can allow exhaust gas to rise and be drawn into the cabin through the fresh air intake without being large enough to produce an audible tick or visible soot at the leak point. A smoke test of the exhaust system from the tailpipe may reveal the small leak.