PRACTICE EXAM 14: ASE A1 ENGINE REPAIR SIMULATION (50 QUESTIONS)

1. A technician is diagnosing a V6 engine with a single-cylinder misfire (P0303) that is present at idle, worsens slightly under light load, but almost disappears at wide-open throttle. The spark plug, coil, and injector on cylinder 3 have been swapped with other cylinders and the misfire remains on cylinder 3. A compression test shows cylinder 3 at 128 PSI while all others are between 150 and 160 PSI. The specification minimum is 140 PSI. A wet test raises cylinder 3 to 132 PSI. Which of the following BEST explains why the misfire diminishes at wide-open throttle?

A. The higher exhaust back-pressure at WOT temporarily improves the valve seat seal on the affected cylinder

B. At WOT, the increased cylinder charge and higher combustion pressure partially compensate for the compression loss and allow marginal combustion to succeed

C. The PCM enriches the fuel mixture at WOT, which masks the misfire by providing excess fuel to the weak cylinder

D. The piston rings seal better at WOT because the higher RPM creates centrifugal force that presses the rings outward

2. A customer brings in a vehicle stating that the engine oil looks "sparkly" when checked with a flashlight on the dipstick. The oil change was performed 2,000 miles ago. The engine sounds normal and performs well. Oil pressure is within specification. The technician drains a sample and confirms fine metallic particles are visible throughout the oil. Which of the following is the MOST appropriate FIRST action?

A. Perform a compression test to determine if piston ring material is being shed into the oil supply

B. Add a magnetic drain plug at the next oil change to capture and identify the metal type over time

C. Immediately disassemble the engine because metallic particles always indicate imminent bearing failure

D. Cut open the oil filter to examine the quantity and type of metallic debris trapped in the filter media

3. A rebuilt engine develops an intermittent high-pitched squeal from the front of the engine that lasts 2 to 3 seconds and occurs only during rapid acceleration from idle. The squeal does not occur at steady

cruise, at idle, or during deceleration. The serpentine belt was replaced during the rebuild. Which of the following is the MOST likely cause?

A. The serpentine belt is slipping on the crankshaft pulley during the sudden torque demand of rapid acceleration

B. The timing chain tensioner is momentarily losing tension during the rapid RPM change and the chain whips

C. A new alternator bearing that produces noise under the increased load demand of rapid acceleration

D. The water pump impeller is cavitating momentarily during the sudden increase in coolant flow demand

4. A technician is measuring the bore on a six-cylinder engine during a rebuild. Cylinder 2 shows 0.0025 inches of taper and 0.0018 inches of out-of-round. The specification allows 0.003 inches maximum taper and 0.0015 inches maximum out-of-round. All other cylinders are within both specifications. Which of the following is the correct repair decision for cylinder 2?

A. Both measurements are within specification so the bore can be honed and reused with standard rings

B. The taper is within specification but the out-of-round is acceptable since it exceeds by only 0.0003 inches

C. The taper is within specification but the out-of-round exceeds the maximum, so cylinder 2 must be bored

D. Both taper and out-of-round exceed specification and all six cylinders should be bored to match

5. Technician A says that a head gasket failure can cause the engine to overheat, consume coolant, produce white exhaust smoke, contaminate the oil, and cause low compression — all from a single gasket breach location. Technician B says that a head gasket can fail in multiple locations simultaneously, with each breach producing different symptoms. 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

6. A four-cylinder turbocharged engine with 95,000 miles has been consuming one quart of oil every 800 miles for the past 20,000 miles. There is no visible exhaust smoke at idle, during acceleration, or during deceleration. The PCV system is functional. Compression is within specification on all cylinders. The turbocharger shaft has no measurable radial or axial play. The customer asks the technician to explain how oil can be consumed with no visible smoke. Which of the following is the correct explanation?

A. The oil is being lost externally through a slow leak that evaporates on a hot engine surface before dripping

B. The oil consumption rate is within the manufacturer's normal specification and represents no actual loss

C. The oil is being drawn into the crankcase breather system and consumed through the PCV circuit without visible exhaust evidence

D. The catalytic converter is burning the small amount of oil vapor in the exhaust before it can exit the tailpipe as visible smoke

7. A technician is inspecting a crankshaft that was removed from an engine with a rod bearing failure on cylinder 4. The number 4 rod journal has deep scoring and heat discoloration. All other rod journals appear undamaged with smooth, polished surfaces. The technician measures all rod journals and finds only the number 4 journal below the standard minimum diameter. Which of the following is the correct repair approach?

A. Regrind only the number 4 rod journal to the first undersize and install undersize bearings on that rod only

B. Regrind all rod journals to the same undersize to maintain uniform bearing size and oil clearance specification throughout the engine

C. Replace the crankshaft because regrinding only one journal creates an imbalance in oil distribution

D. Regrind only the number 4 journal but also regrind the two adjacent main journals as a precaution

8. A customer reports that the engine temperature gauge drops below the normal range during sustained highway driving at 70 mph in winter temperatures of 10°F. The heater output becomes lukewarm during this condition. Once the vehicle returns to city driving, the gauge returns to the normal midpoint and heater output improves. The cooling fan does not run during the highway episode. Which of the following is the MOST likely cause?

A. A radiator that is too large for the application, causing excessive heat dissipation at highway airflow

B. The engine thermostat was removed during a previous service and was never reinstalled in the housing

C. A thermostat that opens at a lower temperature than its rated specification, allowing premature coolant flow

D. A missing or damaged air dam below the front bumper that allows excessive cold air to reach the radiator

9. A technician performs a leak-down test on a four-cylinder engine. All cylinders show less than 8% leakage with faint air audible at the oil filler cap — consistent with normal ring bypass. However, on cylinder 2, in addition to the faint air at the oil filler cap, the technician notices a very slight but continuous stream of tiny bubbles in the coolant recovery tank. Cylinder 2 compression is 148 PSI — within the 140 to 165 PSI specification. Which of the following is the correct interpretation?

A. Cylinder 2 has a very minor head gasket breach to a coolant passage that has not yet affected compression significantly but is allowing compressed air into the coolant during the leak-down test

B. The bubbles in the coolant are caused by trapped air from a recent coolant service and are unrelated to the leak-down test being performed

C. The leak-down tester is malfunctioning and producing false readings on cylinder 2 only during this test

D. Cylinder 2 has a cracked block between the bore and a coolant passage that is not yet severe enough to affect compression readings

10. A rebuilt engine is started for the first time. Oil pressure immediately reaches 55 PSI. The engine sounds smooth with no knocks or ticks. However, after 30 seconds of running, the technician notices that the exhaust from all four cylinders has a strong, acrid chemical smell that is distinctly different from normal exhaust. No smoke is visible. The smell gradually diminishes over the next five minutes. Which of the following BEST explains this smell?

A. Residual cleaning solvent in the coolant passages is being heated and its vapors are entering the exhaust

B. The valve stem seals are leaking assembly lubricant into all four combustion chambers simultaneously

C. The new exhaust manifold gaskets are outgassing as their composite material heats for the first time

D. Assembly lubricant, anti-seize compound, and thread sealant used during the build are burning off on the hot exhaust manifold and exhaust pipe surfaces

11. A vehicle with an inline-4 engine has a rough idle with a vacuum reading that fluctuates between 12 and 17 in. Hg in an irregular, non-rhythmic pattern. The fluctuation does not correspond to any single cylinder's firing frequency. Compression is within specification on all cylinders. Long-term fuel trim is plus 14% on bank 1. Which of the following is the MOST likely cause?

A. A large vacuum leak that creates turbulent airflow in the manifold, producing an irregular vacuum fluctuation pattern

B. Multiple burned valves on different cylinders that produce overlapping vacuum dips at irregular intervals

C. A worn camshaft with multiple low lobes producing an uneven firing pattern that disrupts vacuum consistency

D. A partially clogged catalytic converter that produces pulsating back-pressure at irregular time intervals

12. A technician is reassembling a DOHC cylinder head after a valve job. All valves have been lapped to their seats and show complete contact rings. New valve stem seals have been installed. During spring installation on the number 4 intake valve, the technician notices that the spring does not compress as much as the springs on the other valves — the keepers barely reach the groove in the valve stem before the spring bottoms against the retainer. Which of the following is the MOST likely cause?

A. The number 4 intake valve is the wrong length for this application and is too long for the spring assembly

B. The valve spring installed height is incorrect because the valve seat was cut too deeply during reconditioning

C. The wrong valve spring was installed at the number 4 intake position — it is too short or has too many coils

D. The valve guide on the number 4 intake was pressed in too deep, raising the valve higher than the other positions

13. A customer brings in a vehicle with a four-cylinder engine that has had the head gasket replaced three times in two years. Each time, the repair was performed by a different shop. Each shop reported

that the head was resurfaced, new TTY bolts were used, and the gasket was installed correctly. The customer asks the technician to determine why the gasket keeps failing. Which of the following underlying causes is MOST likely being overlooked?

A. The head bolt threads in the block have become damaged from repeated bolt installation and removal cycles

B. The head is cracking in a location that is not being detected by the surface inspection performed at each repair

C. Each shop used the wrong torque sequence, but the error is different each time, causing failure at different locations

D. The root cause of the original overheating event — such as a cooling system component failure — has never been identified and corrected

14. A technician discovers during a rebuild that one of the pistons has a small but visible crack on the piston crown surface, approximately 0.25 inches long, running between two valve relief notches. The crack does not appear to extend through the full thickness of the crown. Which of the following is the correct action?

A. Monitor the crack during break-in by performing a borescope inspection through the spark plug hole at 500 miles

B. Replace the piston because even a small crown crack can propagate under the thermal and pressure cycling of combustion

C. Fill the crack with high-temperature metallic epoxy and sand it flush before installing the piston in the bore

D. Install the piston as-is because crown cracks between valve reliefs are a common cosmetic casting mark

15. A six-cylinder engine has been running for 50,000 miles since its last timing chain replacement. The engine now exhibits a check engine light with code P0017 (crankshaft to camshaft correlation, bank 1, sensor B — exhaust). The engine runs rough at idle but smooths out above 2,000 RPM. A scan tool shows the exhaust camshaft position is approximately 5 degrees retarded from the commanded position. Oil changes have been performed at correct intervals with the specified oil. Which of the following is the MOST likely cause?

A. The exhaust camshaft position sensor has failed and is reporting incorrect position data to the PCM

B. The timing chain has stretched enough in 50,000 miles to produce a 5-degree deviation on the exhaust cam

C. The exhaust cam VVT oil control valve is clogged or the exhaust cam phaser has worn internally and cannot achieve the commanded position

D. The PCM has a software calibration error that is commanding an incorrect exhaust cam position target

16. Technician A says that when an engine misfires under load but not at idle, the cause is more likely ignition-related than mechanical. Technician B says that a compression problem can cause a misfire at idle that clears under load because increased cylinder pressure helps seal marginal rings. Who is correct?

A. Technician A only

B. Both Technician A and Technician B

C. Technician B only

D. Neither Technician A nor Technician B

17. A freshly rebuilt engine has been running for 200 miles. The technician checks the torque on the intake manifold bolts and discovers that three of the twelve bolts have lost approximately 10% of their specified torque — they turn an additional 5 degrees before the torque wrench clicks. The remaining nine bolts are at specification. Which of the following BEST explains this finding?

A. Normal bolt relaxation during initial thermal cycling as the gasket compresses to its final thickness under repeated heat and cool cycles

B. The three loose bolts were undertorqued during initial assembly and have been slowly loosening from vibration

C. The intake manifold gasket has partially compressed and failed at those three bolt locations specifically

D. The aluminum intake manifold has warped from heat cycling and is pulling away from the head at those locations

18. A four-cylinder engine exhibits a condition where the engine oil level on the dipstick rises approximately half a quart above the full mark over a period of two weeks. The oil does not smell like

fuel, does not appear milky, and has a normal dark brown color. The vehicle is equipped with a liquid-cooled engine oil cooler. The coolant level in the reservoir has dropped by approximately the same amount. Which of the following is the MOST likely cause?

A. A leaking oil pan gasket that allows crankcase pressure to push oil upward past the dipstick seal

B. Condensation from temperature cycling that is accumulating in the crankcase from humid conditions

C. The engine is burning oil and coolant simultaneously through a head gasket breach, but the volumes cancel out

D. A failed internal barrier in the liquid-cooled oil cooler allowing coolant to cross into the oil under the cooling system's higher operating pressure

19. A technician is diagnosing an engine that produces a metallic clicking noise at idle. The noise is isolated to the number 5 intake rocker arm on a V8 OHV engine. The technician adjusts the rocker arm to zero lash plus the specified preload. The noise temporarily stops but returns within 15 minutes. The technician readjusts — the noise stops and returns again. Which of the following is the MOST likely cause?

A. The rocker arm adjusting nut is not locking properly and is backing off from vibration each time

B. The pushrod for the number 5 intake is slightly bent and is not maintaining consistent geometry

C. The hydraulic lifter at the number 5 intake position has an internal defect that prevents it from holding its oil charge

D. The camshaft lobe for the number 5 intake has developed a flat spot that produces a momentary clearance each revolution

20. A customer reports that after a head gasket repair, the engine runs normally but the heater only blows lukewarm air at best. The temperature gauge reads normal. The upper radiator hose is hot. The lower radiator hose is warm. Both heater hoses at the firewall feel equally warm — but not hot. Which of the following is the MOST likely cause?

A. The thermostat installed during the repair is a lower temperature rating than the original specification

B. An air pocket trapped in the heater core circuit that is reducing coolant flow and heat transfer through the core

C. The water pump installed during the service has a smaller impeller that reduces flow to the heater circuit

D. The replacement head gasket is restricting a coolant passage that feeds the heater core supply port

21. A technician is testing the oil pump on a bench before installation during an engine rebuild. The technician fills the pump with clean oil, installs it in a vise, and uses a drill to spin the pump drive shaft. Oil flows freely from the outlet. The technician then blocks the outlet with a finger and continues spinning — the pump does not build any noticeable pressure against the blocked outlet. Which of the following does this indicate?

A. The pump is functioning normally because bench testing with a drill does not produce realistic RPM

B. The pump gears have excessive internal clearances that allow oil to leak back from outlet to inlet

C. The pump is a variable-displacement design that reduces output when back-pressure is detected

D. The drill is spinning the pump shaft in the wrong direction, which reverses the pump's flow path

22. A technician discovers during an engine teardown that the number 3 piston has a section of the top ring land broken off — approximately one-third of the ring land circumference is missing. The piston also shows impact marks on the crown. The engine was running when the damage occurred. Which of the following is the MOST likely cause?

A. Severe detonation that produced pressure waves strong enough to break the ring land and impact the piston crown from the combustion side

B. A valve that contacted the piston crown due to a timing chain failure, breaking the ring land from above

C. The piston overheated from a clogged cooling jet and the thermal stress cracked the ring land from expansion

D. The piston was defective from manufacturing and the ring land failure was a latent material weakness

23. A V6 engine exhibits a vacuum gauge pattern where the needle drops 3 to 4 in. Hg every 2 to 3 seconds in a regular, rhythmic pattern at idle, then recovers. The drops are sharp and brief — like a heartbeat dip. A cylinder power balance test shows that disabling cylinder 6 smooths the vacuum reading. The compression on cylinder 6 is 148 PSI — within the 140 to 165 specification. A leak-down test on cylinder 6 shows 12% leakage with faint air at the tailpipe. Which of the following BEST

explains how cylinder 6 can cause a vacuum fluctuation despite having compression within specification?

A. The fuel injector on cylinder 6 has a slight over-delivery that enriches that cylinder and disrupts combustion

B. The compression reading is taken during cranking, not running — a valve can seat adequately during slow cranking but leak under the dynamic conditions of running

C. The ignition coil on cylinder 6 has an intermittent misfire that coincides with the vacuum dips observed

D. The exhaust valve on cylinder 6 is marginally not sealing — good enough to produce near-normal cranking compression but leaking enough during running to cause a measurable vacuum dip each cycle

24. Technician A says that an oil pump pressure relief valve that is stuck closed will cause the oil pressure gauge to read maximum at all RPMs and can blow out oil filter gaskets. Technician B says that a pressure relief valve stuck partially open will cause oil pressure to be capped at a lower-than-normal maximum regardless of engine RPM. Who is correct?

A. Technician A only

B. Both Technician A and Technician B

C. Technician B only

D. Neither Technician A nor Technician B

25. A vehicle with a known exhaust valve guide wear problem on cylinder 2 is being evaluated for repair. The customer wants to minimize cost. The guide clearance on cylinder 2 exhaust is 0.006 inches — double the 0.003-inch maximum specification. All other guides are within specification. The technician recommends replacing the valve stem seal on cylinder 2 as a temporary measure. Which of the following statements about this recommendation is correct?

A. Replacing only the seal is a complete repair because the seal controls all oil flow past the guide

B. The seal replacement will reduce smoke temporarily but will not last because the excessive guide clearance prevents the new seal from maintaining contact

C. Replacing the seal will make no difference at all because the seal does not control oil flow past the valve guide

D. The seal will last as long as a seal on a good guide because the seal rides on the valve stem, not the guide

26. A technician is performing a cooling system inspection on a vehicle that intermittently overheats. During the inspection, the technician squeezes the upper radiator hose while the engine is running at operating temperature and the thermostat is open. The hose feels pressurized but the technician can compress it partially with moderate hand pressure. The system is rated at 16 PSI. Which of the following is the correct interpretation?

A. This is normal — a radiator hose at operating pressure should compress partially and is not rigid like a hydraulic line

B. The hose should be rock-hard at 16 PSI and the compressibility indicates the cap is not maintaining pressure

C. The compressibility indicates an air pocket in the system that is acting as a compressible cushion in the hose

D. The water pump is not generating adequate flow, which reduces the perceived pressure in the upper hose

27. A four-cylinder engine has been diagnosed with a head gasket failure between cylinder 3 and a coolant passage. Before the head is removed, the technician notes that the engine oil is clean with no evidence of coolant contamination. After removing the head, the technician inspects the failed gasket area and confirms a breach from the number 3 combustion chamber to a coolant passage — but the breach is directional, pointing from the combustion chamber outward toward the coolant passage, not inward. Which of the following explains why the oil was not contaminated despite the gasket failure?

A. The failure was too recent for coolant to have reached the oil system through the coolant passages

B. The breach allowed high-pressure combustion gas to push into the coolant (causing overheating and coolant loss) but the combustion pressure was always higher than coolant pressure, preventing coolant from flowing backward into the cylinder or oil system

C. The coolant and oil passages in this engine's head gasket are not adjacent to each other near cylinder 3

D. The engine's oil cooler filtered out any coolant that entered the oil before it could contaminate the dipstick sample

28. A technician is assembling a rebuilt engine and discovers that the piston for cylinder 1 has a directional marking (an arrow) on the piston crown. The technician is unsure which direction the arrow should face. The engine's service manual is not available. Which of the following is the MOST reliable method to determine the correct orientation?

A. Install the piston with the arrow facing the exhaust side of the engine because that is the standard convention

B. Contact the piston manufacturer's technical support line or website to confirm the directional marking meaning

C. Install the piston with the arrow facing the intake side because the valve relief notches must clear the intake valves

D. Look up the specific piston's directional requirement from the piston manufacturer's documentation or the engine builder's reference because arrow conventions vary between manufacturers

29. A customer reports that the engine developed a sudden loud rattling noise from the timing chain area while driving, followed immediately by a check engine light and rough running. The engine is still running but very rough. A scan tool shows misfire codes on cylinders 1, 2, and 3. Cylinders 4, 5, and 6 show no misfires. The engine is a V6 with separate timing chains for each bank. Which of the following MOST likely occurred?

A. The timing chain on bank 1 (cylinders 1, 2, 3) failed or jumped multiple teeth, causing valve timing loss and misfires on that bank only

B. The single timing chain connecting both banks stretched suddenly and affected the front bank more than the rear

C. The camshaft position sensor on bank 1 failed and the PCM shut down ignition to that bank as a protective measure

D. Three ignition coils on bank 1 failed simultaneously due to a wiring harness fault at the coil connector

30. A technician is performing a valve adjustment on a DOHC engine with solid lifters. The specification for intake valve clearance is 0.008 to 0.010 inches. The number 1 intake measures 0.004 inches. Which of the following describes both the condition and the correct repair?

A. The clearance is too loose and a thicker shim must be installed to reduce the gap to specification

B. The clearance is acceptable because 0.004 inches is close enough to the 0.008 minimum specification

C. The clearance is too tight and a thinner shim must be installed to increase the gap to specification

D. The clearance is too tight and the valve stem tip must be ground to shorten the valve and increase clearance

31. A technician is inspecting the flywheel on a high-mileage vehicle during a clutch replacement. The flywheel friction surface has a slight blue discoloration at the outer edge and the surface shows light scoring marks running in a circular pattern. There is no warpage, cracking, or runout. Which of the following is the correct action?

A. Replace the flywheel because blue discoloration indicates the metal has been overheated and hardened

B. Reinstall the flywheel as-is because the blue discoloration and light scoring are normal wear patterns

C. Replace the flywheel with a new unit because any surface discoloration makes the friction surface unsuitable

D. Resurface the flywheel to remove the discolored and scored layer and restore a flat, smooth friction surface

32. An engine has been diagnosed with worn connecting rod bearings on cylinders 2 and 5 of a V8 engine. During disassembly, the technician discovers that the oil filter was an incorrect part number — the wrong application had been installed for at least two oil changes. The incorrect filter has a lower flow capacity than specified. Which of the following BEST explains how the wrong filter may have contributed to the bearing wear?

A. The restricted filter caused the bypass valve to open frequently, sending unfiltered oil to all bearings

B. The restricted filter caused higher-than-normal oil pressure that overloaded the bearing surfaces

C. The wrong filter had an incompatible gasket that allowed unfiltered oil to leak past the filter base plate

D. The lower flow capacity filter reduced total system oil volume, causing intermittent oil starvation at higher RPM

33. A technician replaces the water pump on a vehicle and refills the cooling system. After running the engine for 20 minutes, the temperature stabilizes at normal. The technician releases the vehicle. The

customer returns two days later stating the engine overheated on the highway. The coolant level is significantly low. There are no visible external leaks. The technician pressure-tests the system and it holds perfectly. A block test is negative. Which of the following is the MOST likely cause of the coolant loss?

A. The new water pump has an internal leak that only occurs at the higher RPM of highway driving

B. A hose clamp loosened from thermal cycling and leaked coolant at highway speed then resealed when cool

C. Air trapped in the cooling system during the refill expanded when the engine reached full highway temperature, displaced coolant to the overflow, and the coolant was not drawn back because the cap vacuum valve is stuck closed

D. The head gasket developed a small breach from the overheating event that only leaks under highway load

34. Technician A says that when measuring cylinder bore taper, the largest measurement should be taken at the top of ring travel where wear is greatest. Technician B says that the smallest measurement should be taken at the bottom of ring travel where wear is least. 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

35. A vehicle owner brings in a car stating that after running over a large piece of road debris, the engine developed a significant oil leak from underneath. The technician raises the vehicle and finds the oil pan has a visible dent where the debris struck, and oil is seeping from a crack in the pan at the dent location. The oil level is two quarts low. Which of the following is the MOST critical concern beyond the obvious pan damage?

A. The crankshaft counterweights may have been damaged from the pan being pushed upward into them

B. The oil pickup tube may have been bent upward by the dented pan, reducing or eliminating its submersion

C. The catalytic converter may have been damaged by the same road debris impact that hit the oil pan

D. The dented pan may have compressed against the oil pump pickup, restricting flow or bending the tube and screen assembly upward

36. A technician discovers that an engine has been assembled with the oil pump drive shaft indexed one tooth off from its correct timing position. The engine has not yet been started. A colleague tells the technician this does not matter because oil pump timing does not affect pump function. Which of the following is the correct response?

A. The colleague is wrong — the oil pump drive must be precisely timed to deliver oil at specific crankshaft positions

B. The colleague is correct — oil pump drive timing does not affect pump function because the pump is a positive-displacement device that works regardless of indexing

C. The colleague is partially correct — the indexing affects only the distributor timing on engines with a distributor, not the oil pump itself

D. The colleague is wrong — the incorrect indexing will cause the pump to rotate in reverse and damage the engine

37. A technician performs a cooling system inspection and discovers that the coolant in the radiator appears normal (clean, correct color) but the coolant in the overflow recovery tank is a different color — darker and with a slight oily sheen. The radiator coolant tests at the correct freeze protection level. Which of the following is the MOST likely explanation?

A. The overflow tank has never been drained during previous coolant services and contains old degraded coolant

B. A head gasket breach is allowing oil and combustion gas into the overflow tank through the overflow tube

C. The overflow tank coolant has been contaminated by the difference in coolant types between old and new

D. The radiator cap is malfunctioning and pushing contaminated coolant to the overflow while retaining clean coolant

38. A V8 engine with 180,000 miles produces a deep, rhythmic thud from the lower engine area at idle. The noise does not change when individual cylinders are disabled. Oil pressure is 10 PSI at hot idle —

the specification minimum is 10 PSI. At 2,000 RPM, oil pressure rises to 32 PSI and the thudding diminishes but does not disappear. Which of the following BEST describes this engine's condition?

A. The main bearings are severely worn, producing the thud that is not affected by single-cylinder disable and causing oil pressure at the absolute minimum specification at idle

B. A cracked flexplate is producing the rhythmic thud and the low oil pressure is a separate unrelated issue

C. The oil pump is failing and producing cavitation noise that sounds like a lower-engine thud at idle speed

D. The crankshaft thrust bearing is worn and producing the thud from excessive axial movement at idle

39. A technician is diagnosing a vehicle that has been brought in repeatedly for an oil consumption complaint. The engine uses one quart every 2,500 miles. The manufacturer states this is within normal parameters. Previous technicians have performed compression tests, leak-down tests, and smoke tests — all normal. The PCV system is functioning correctly. There are no external leaks. The customer insists the consumption is abnormal because their previous vehicle (a different manufacturer) used no measurable oil. Which of the following is the MOST appropriate course of action?

A. Perform additional diagnostic tests that may reveal a subtle problem the previous technicians missed

B. Replace the valve stem seals preemptively because they are the most likely cause of marginal consumption

C. Recommend a heavier-viscosity oil than the manufacturer specifies to reduce the oil consumption rate

D. Explain to the customer that all diagnostic tests confirm normal operation and the consumption rate falls within the manufacturer's published acceptable range for this specific engine

40. A technician is replacing the intake manifold gaskets on a V6 engine. During reassembly, the technician notices that one of the intake manifold bolts bottoms out in its hole before the manifold flange is fully seated against the cylinder head. All other bolts draw the manifold down evenly. Which of the following is the MOST likely cause and correct action?

A. The bolt is too long for that specific location — verify the correct bolt length for each position per the manufacturer's diagram

B. The bolt hole has been drilled too deeply at the factory — install a hardened washer under the bolt head as a spacer

C. Thread sealant at the bottom of the hole is preventing the bolt from threading fully — chase the threads and clean the hole

D. The bolt is the correct length but has been cross-threaded into the hole — remove it and repair the threads

41. A customer brings in a vehicle reporting that the engine cranks but does not start after the vehicle sat in a cold garage for three months during winter. The battery was on a trickle charger and cranks the engine at normal speed. Fuel pressure reaches specification within 2 seconds of key-on. A spark test confirms strong spark on all cylinders. A compression test shows all four cylinders between 50 and 70 PSI — well below the 140 to 160 PSI specification. The engine has 60,000 miles with no previous mechanical problems. Which of the following is the MOST likely cause of the universally low compression?

A. The piston rings have stuck in their grooves from varnish and moisture accumulation during the three-month sitting period

B. The timing belt has jumped three or more teeth from the tension loss during the extended cold storage period

C. All four cylinders have simultaneously developed burned exhaust valves from the cold storage condition

D. The engine oil has thickened from cold temperatures and is preventing the piston rings from sealing the bore

42. A technician discovers during a rebuild that the number 2 main bearing bore in the engine block is 0.003 inches larger in diameter than the other four main bearing bores when measured with the cap torqued to specification. All caps are in their correct positions and orientations. Which of the following is the MOST likely cause of the enlarged bore?

A. The number 2 cap was over-torqued during the previous assembly and permanently deformed the bore

B. A previous technician installed an incorrect thickness bearing in that position, causing accelerated wear

C. The number 2 main bearing position experienced a localized failure that spun the bearing and damaged the bore

D. The block has a casting porosity defect at the number 2 position that has enlarged under repeated stress

43. A vehicle is brought in for diagnosis after the engine suddenly lost all power while driving at highway speed and will not restart. The engine cranks freely at normal speed. A compression test shows 0 PSI on all four cylinders. The timing belt cover is intact and shows no external damage. Which of the following should the technician verify FIRST?

A. Whether the fuel pump is delivering fuel because a fuel starvation condition can mimic zero compression

B. Whether the engine has hydrostatic lock from coolant that has filled the cylinders through a head gasket failure

C. Whether the exhaust is blocked by a collapsed catalytic converter that is preventing any cylinder from building pressure

D. Whether the timing belt has broken by removing the cover and inspecting the belt, or by verifying that the camshaft rotates when the crankshaft is turned

44. A freshly rebuilt engine has been running for 5,000 miles with no issues. The customer returns reporting a new ticking noise from the valvetrain that appeared within the last week. The engine is an OHV design with hydraulic lifters. Oil level is correct and oil pressure is within specification. The technician isolates the tick to the number 6 exhaust rocker arm. Adjusting the rocker arm temporarily silences the tick, but it returns within an hour. Which of the following is the MOST likely cause?

A. The camshaft exhaust lobe for cylinder 6 has begun to wear and is losing lift progressively

B. The hydraulic lifter at the number 6 exhaust position has developed an internal check valve leak that allows it to bleed down faster than it can refill

C. The pushrod at the number 6 exhaust position has bent from a pre-ignition event on that cylinder

D. The rocker arm pivot on the number 6 exhaust has worn and is allowing excessive play under load

45. A technician is performing an oil pressure test on a vehicle with 200,000 miles. Hot idle pressure is 12 PSI (specification minimum is 10 PSI). Hot 2,500 RPM pressure is 38 PSI (specification is 40 to 65 PSI). The customer asks if the engine will last another 20,000 miles. Which of the following is the MOST accurate response?

A. The idle pressure is above minimum but the speed pressure is below specification, indicating progressive bearing wear that will continue to worsen and may eventually cause bearing failure

B. Both readings are within specification and the engine should last 20,000 miles without any concerns

C. Both readings indicate the oil pump is failing and should be replaced before the engine is driven further

D. The readings indicate the engine has approximately 5,000 miles of remaining life before bearing failure

46. Technician A says that when a piston ring is installed upside down, the ring will pump oil upward into the combustion chamber instead of scraping it downward into the crankcase. Technician B says that an upside-down ring can be identified during assembly by checking for the "TOP" dot or marking on the ring surface. 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

47. An engine is brought in after the customer heard a loud snap followed by a sudden loss of power. The engine continues to run but misfires badly on two adjacent cylinders. A compression test shows those two cylinders at approximately 50 PSI while all others are normal. A vacuum gauge shows a rhythmic fluctuation corresponding to the two affected cylinders. A leak-down test on one of the affected cylinders shows air escaping from the adjacent cylinder's spark plug hole. Which of the following has MOST likely occurred?

A. The exhaust valves on both cylinders burned through simultaneously from a pre-existing lean condition

B. A piston on one of the affected cylinders cracked and debris damaged both cylinders' ring seals

C. The intake manifold gasket has failed between both runners, allowing air to cross-communicate between them

D. The head gasket has blown between the two adjacent cylinders, allowing compression to cross-leak

48. A rebuilt engine is being started for the first time. The technician pre-primed the oil system, and pressure reached 40 PSI during priming. The engine starts and runs, but oil pressure on the gauge reads only 15 PSI at idle — far below the 25 PSI minimum specification. At 2,500 RPM, pressure reads only 20 PSI. The technician shut the engine off immediately. Which of the following assembly errors is MOST likely responsible for the critically low pressure after a successful pre-prime?

A. The main bearing clearances are too tight and are restricting oil flow through the bearing journals

B. The oil pump was installed with the relief valve spring left out or installed incorrectly, allowing unregulated bypass at all pressures

C. The oil filter installed is the wrong application and has a higher bypass pressure than the system can produce

D. The oil pickup tube-to-pump seal is leaking air under the higher suction demand of the running pump compared to the slower pre-prime

49. A customer reports that the engine has developed a single loud exhaust backfire approximately once per week — always during highway driving, never at idle or during city driving. The backfire occurs without warning and the engine continues to run normally afterward. No codes are stored. All engine mechanical tests are normal. Which of the following is the MOST likely cause?

A. An intermittent ignition misfire on one cylinder that allows unburned fuel to reach the hot exhaust system and ignite sporadically during highway conditions

B. A failing catalytic converter that randomly ignites stored fuel vapor during sustained high-temperature operation

C. A cracked exhaust manifold that intermittently draws air into the exhaust stream and creates a combustible mixture

D. An EVAP system purge event that introduces a large fuel vapor bolus into the intake at an inopportune moment

50. A technician has completed a comprehensive engine rebuild — new bearings, rings, gaskets, timing components, and all specifications verified during assembly. The engine has been run through three heat cycles with no leaks, normal oil pressure, normal compression, and a negative block test. Before delivering the vehicle, the technician should perform one final verification. Which of the following is the MOST comprehensive final check?

A. A dyno test to verify the engine produces its rated horsepower output at the specified RPM range

B. An oil analysis submitted to a laboratory to establish the baseline wear metal profile for future comparison

C. A thorough road test under varied conditions — cold start, warm-up, idle, cruise, full acceleration, deceleration, and hill climbing — to exercise all engine systems under real-world operating loads

D. A full leak-down test on all cylinders to document the baseline sealing condition of each cylinder for reference

Practice Exam 14: 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 — At idle, cylinder pressures are at their lowest, and a cylinder with 128 PSI (below the 140 minimum) cannot sustain consistent combustion at these marginal pressures. [A] At wide-open throttle, the dramatically increased cylinder charge volume and higher resulting combustion pressures partially compensate for the valve leak — the greater mass of air-fuel in the cylinder means even with some leakage past the valve, enough charge remains to produce a combustible event. The minimal wet test improvement (128 to 132) confirms the valves, not the rings, are the primary leak source.

2. D — Before any further diagnosis, the technician needs to see the metallic debris that the oil filter has captured — its quantity, size, color, and type reveal the source and severity of the wear. [D] Cutting open the filter provides immediate, visual, actionable information: fine aluminum suggests piston or bearing overlay wear, copper indicates bearing substrate exposure, and iron suggests camshaft, crankshaft, or gear wear. This information directs the next diagnostic step — whether an oil pressure test, oil analysis, or teardown is warranted.

3. A — A high-pitched squeal during rapid acceleration from idle that does not occur at steady speed or at idle is the classic presentation of serpentine belt slip under sudden torque demand. [E] When the throttle is opened rapidly from idle, the crankshaft accelerates faster than the belt can transmit the torque to the driven accessories. The belt momentarily slips on the crankshaft pulley — the smoothest and most highly loaded pulley in the drive — producing the brief squeal until the belt catches up. A belt that is slightly undertensioned or glazed is more susceptible.

4. C — Cylinder 2's taper of 0.0025 inches is within the 0.003-inch maximum specification. [C] the out-of-round measurement of 0.0018 inches exceeds the 0.0015-inch maximum specification by 0.0003 inches. While this overage is small, it means the bore is no longer cylindrical enough for new rings to maintain consistent contact around the full circumference. Cylinder 2 must be bored to the next oversize to restore a true round bore. The remaining five cylinders can be honed with standard rings.

5. A — Both technicians are correct. [A] Technician A correctly describes how a single gasket breach between a combustion chamber and a coolant passage can produce multiple symptoms simultaneously — the high-pressure combustion gas pushes into the coolant (causing overheating and coolant loss), coolant is drawn into the cylinder (producing white smoke and low compression), and coolant can migrate to the oil return area (contaminating the oil). Technician B correctly notes that a gasket can fail at multiple independent locations, each producing its own set of symptoms.

6. D — An engine consuming one quart per 800 miles with no visible exhaust smoke, despite all mechanical tests being normal, is burning oil that the catalytic converter eliminates before it exits the tailpipe. [E] The catalytic converter operates at temperatures exceeding 1,200°F and is highly efficient at oxidizing the small volume of oil hydrocarbons that pass through it in the exhaust stream. The oil is being consumed in the combustion chambers — through minor ring bypass, valve guide clearance, or PCV vapor — but the converter destroys the visible evidence.

7. B — When only one rod journal is damaged and all others are within specification, the standard and most cost-effective practice is to regrind only the damaged journal. [C] Installing undersize bearings on the reground journal and standard bearings on all other journals is an accepted and common repair. Each bearing position is an independent lubrication system — each journal and bearing set maintains its own clearance. There is no imbalance created by having one undersize bearing set in the engine.

8. C — An engine that overcools during sustained highway driving in winter — with reduced heater output and the gauge dropping below normal — has a thermostat that is allowing coolant to flow to the radiator prematurely. [D] A thermostat opening at a lower temperature than its rated specification allows coolant to reach the radiator before the engine has fully warmed, and the combination of high ram airflow at 70 mph and 10°F ambient temperatures removes heat faster than the engine produces it at highway cruise. A correctly rated thermostat would remain closed until the proper temperature, preventing overcooling.

9. A — Cylinder 2 has 148 PSI compression (within specification) and only faint ring bypass on the leak-down — but the steady bubbles in the coolant during the leak-down test reveal a second, separate leak path from the combustion chamber to a coolant passage through the head gasket. [A] The breach is small enough that it has not yet affected compression — the leak path to coolant allows only a minor volume of gas to escape during the brief compression event. This is an early-stage head gasket failure that will progressively worsen. The block test at idle may still be negative because the breach is too small at low RPM.

10. D — Assembly lubricant (moly paste), anti-seize compound (on exhaust manifold studs), thread sealant (on coolant bolts), and gasket dressing all contain chemical compounds that produce acrid,

chemical-smelling vapors when exposed to the extreme heat of the exhaust manifold and pipes for the first time. [A] This is a normal and expected occurrence on any freshly assembled engine. The smell diminishes as these materials burn off completely within the first several minutes of operation. No corrective action is needed — the technician should confirm the smell resolves and monitor for any persistent odors that could indicate an actual leak.

11. A — An irregular, non-rhythmic vacuum fluctuation between 12 and 17 in. Hg that does not correspond to any single cylinder's firing frequency, combined with plus 14% long-term fuel trim (lean), points to a significant vacuum leak creating turbulent airflow in the intake manifold. [A] A large vacuum leak introduces unmetered air that disrupts the smooth laminar flow pattern in the manifold, producing the irregular fluctuation as the turbulent air randomly affects different cylinders. The elevated fuel trim confirms the PCM is adding fuel to compensate for the lean condition caused by the unmetered air.

12. C — During spring installation, if one spring barely reaches the keeper grooves before bottoming out while all others compress with adequate travel remaining, the spring at that position is either too short, has too many active coils, or has a higher spring rate than specified. [B] The most likely cause is that a wrong spring was placed at the number 4 intake position — possibly a spring from a different engine application or a spring intended for the exhaust position where different specifications may apply. The technician should verify the spring's part number and free height against the correct specification.

13. D — Three head gasket failures in two years on the same engine, despite proper repairs each time, is the hallmark of an uncorrected root cause — the original condition that caused the first gasket failure is still present and destroys each new gasket. [D] The most common root cause is a cooling system fault — a partially restricted radiator, a failing water pump, a weak radiator cap, an inoperative cooling fan, or a blocked coolant passage — that was never identified because each shop focused only on the gasket repair. Until the source of the original overheating is found and corrected, gaskets will continue to fail.

14. B — A crack on a piston crown — even a small one that does not appear to penetrate the full thickness — represents a structural failure that will propagate under the extreme thermal and mechanical cycling of combustion. [C] Combustion produces pressures exceeding 1,000 PSI and temperatures exceeding 4,000°F at the piston crown. Every power stroke stress-cycles the crack, driving it deeper. What appears as a surface crack today becomes a through-crack that allows combustion gas into the crankcase or breaks a section of the crown off entirely. The piston must be replaced.

15. C — A P0017 code indicating the exhaust camshaft is 5 degrees retarded from the commanded position, with rough idle that improves above 2,000 RPM and proper oil maintenance, points to a VVT system mechanical or hydraulic failure rather than a timing chain stretch (which would affect both

cams). [B] The VVT oil control valve for the exhaust cam may be clogged with normal varnish despite correct oil intervals, or the exhaust cam phaser itself has worn internal vane seals that cannot maintain the commanded position. The phaser's inability to hold position is most apparent at idle where oil pressure is lowest.

16. B — Both technicians describe valid diagnostic principles for different misfires. [A] Technician A correctly notes that a load-dependent misfire (present under load, absent at idle) is often ignition-related — higher cylinder pressures under load require higher ignition voltage, and a marginal coil or cracked insulator may fire adequately at idle but fail under load. Technician B correctly describes the opposite scenario — marginal compression that misfires at idle (low pressure) but improves under load when higher cylinder pressures help seat the rings.

17. A — Intake manifold bolt relaxation of approximately 10% during the first several hundred miles of operation is normal and expected on engines with aluminum components and composite gaskets. [B] The gasket material compresses slightly during the initial thermal cycling as the manifold and head expand and contract repeatedly. This settling process reduces the bolt's preload. Some manufacturers specify a retorque procedure after a specified number of heat cycles precisely because this relaxation is a known characteristic.

18. D — An oil level that rises by approximately the same volume that the coolant level drops — with no fuel odor and no milky appearance yet — is the pattern of a liquid-cooled oil cooler internal failure. [D] The oil cooler operates with coolant flowing on one side and oil on the other, separated by an internal barrier. When this barrier ruptures or corrodes through, coolant crosses into the oil side because the cooling system operates at higher pressure (16 PSI) than the crankcase (near atmospheric). The coolant mixes with the oil, raising the level. The discoloration may not be visible yet if the contamination is recent.

19. C — A hydraulic lifter tick that can be temporarily silenced by adjustment but consistently returns indicates the lifter cannot maintain its internal oil charge — it pumps up when adjusted but bleeds down during operation. [B] The lifter's internal check valve or plunger seal has a defect that allows oil to escape from the high-pressure chamber faster than the engine's oil supply can refill it. Each time the technician readjusts, the lifter temporarily pumps up to zero lash, but the internal leak causes it to collapse again within minutes. The lifter must be replaced.

20. B — Both heater hoses at the firewall being warm (but not hot) despite a normal temperature gauge and hot radiator hoses indicates restricted coolant flow through the heater core circuit. [D] An air pocket trapped in the heater core during the coolant refill after the head gasket repair is the most common cause. The air pocket displaces liquid coolant from a portion of the core, reducing the total heat transfer

surface area. The hoses feel warm because some coolant is flowing, but the flow volume is insufficient to heat the core to full temperature. Bleeding the system purges the air and restores full heater performance.

21. C — A bench test where the pump does not build any noticeable pressure when the outlet is blocked indicates the pump cannot develop pressure — oil is leaking internally from the high-pressure outlet side back to the low-pressure inlet side. [D] This confirms excessive internal clearances between the gears and housing that allow oil to recirculate within the pump rather than being forced out the outlet. A functional pump would build significant resistance against a blocked outlet. The pump has worn beyond serviceable limits and must be replaced.

22. A — Severe detonation produces shock waves within the combustion chamber that generate extreme localized pressures — far exceeding normal combustion pressures. [C] These pressure spikes can crack the ring land (the thin wall between ring grooves) at its weakest point — typically between the valve relief notches where material is thinnest. The impact marks on the crown are from the detonation pressure waves hammering the piston surface. This is a classic detonation damage pattern seen in engines running on fuel with insufficient octane or with excessive combustion chamber temperatures.

23. D — The key distinction is between cranking compression (static) and running compression (dynamic). [A] During a compression test, the engine cranks slowly and the valve has more time to seat against the closing force — enough to produce a near-normal reading of 148 PSI. During actual running at idle speed, the valve opens and closes rapidly, and a marginally leaking exhaust valve that seats adequately during slow cranking may not seat fully during the rapid dynamic conditions of running. The 12% leak-down with air at the tailpipe confirms the exhaust valve is the leak path.

24. B — Both technicians correctly describe the two failure modes of the oil pressure relief valve. [D] Technician A is right: a relief valve stuck fully closed never diverts oil, so pressure rises uncontrolled with RPM — potentially blowing out the oil filter gasket, O-rings, or other seals. Technician B is right: a relief valve stuck partially open continuously diverts some oil back to the pan, capping the maximum achievable pressure at whatever level the partial opening allows, regardless of RPM.

25. B — A new valve stem seal installed on a guide with 0.006 inches of clearance (double the specification) will not seal effectively because the excessive guide clearance allows the valve stem to wobble. [B] The seal lip is designed to maintain contact with a stem that moves within a tight tolerance range. When the guide clearance is double the specification, the stem's lateral movement exceeds the seal lip's ability to follow, and oil bypasses the seal. The seal will reduce smoke temporarily but will wear out rapidly as the wobbling stem destroys the seal lip.

26. A — A rubber radiator hose at 16 PSI system pressure should be firm but not rigid — rubber hoses are inherently flexible, and moderate hand compression at normal operating pressure is expected behavior. [D] A cooling system hose is not a hydraulic line; it is a flexible rubber tube designed to absorb vibration and thermal movement. The ability to partially compress the hose with moderate hand pressure does not indicate a pressure problem. The technician should verify the pressure with a gauge at the radiator cap rather than relying on subjective hand-feel of hose rigidity.

27. B — The breach between the combustion chamber and coolant passage is one-directional: combustion pressure (600+ PSI during power strokes) always exceeds coolant pressure (16 PSI system). [D] During every power stroke, high-pressure combustion gas is forced through the breach into the lower-pressure coolant passage, causing coolant loss and overheating. But coolant never flows backward into the cylinder because the combustion pressure is always higher than coolant pressure during the critical moments when the breach is actively leaking. This explains coolant loss with no oil contamination and no coolant-fouled spark plugs.

28. D — Piston directional arrow conventions are not universal — they vary between piston manufacturers. [C] Some manufacturers specify the arrow toward the front of the engine, others toward the exhaust side, and others toward the intake side. Installing the piston based on assumption rather than verified specification risks incorrect valve-to-piston clearance and incorrect piston skirt thrust orientation. The manufacturer's documentation is the only reliable source for the correct orientation.

29. A — Misfires isolated to cylinders 1, 2, and 3 (one bank) with a rattling noise from the timing chain area on a V6 with separate chains for each bank confirms that bank 1's timing chain failed or jumped teeth. [A] The chain failure disrupted valve timing on bank 1 only, causing valves to open and close out of phase with the pistons. If the engine is an interference design, valves may be bent. Bank 2 (cylinders 4, 5, 6) continues to run normally because its chain is independent and unaffected.

30. C — An intake valve clearance of 0.004 inches is below the 0.008-inch minimum specification — the clearance is too tight by 0.004 inches. [B] Insufficient intake valve clearance means the valve may not fully close when the engine is hot and components expand. A valve held slightly open at operating temperature leaks compression, runs hotter (because it cannot transfer heat to the seat), and can eventually burn. A thinner shim increases the gap between the cam follower and the cam base circle, restoring the clearance to within the 0.008 to 0.010 specification.

31. D — A flywheel with slight blue discoloration at the outer edge and light circular scoring marks — without warpage, cracking, or runout — has surface-level heat damage and wear marks that can be corrected by resurfacing. [C] Resurfacing removes the heat-affected surface layer and the scoring, restoring a flat, smooth friction surface with the correct surface finish for the new clutch disc. The blue

discoloration indicates the outer edge reached elevated temperatures but not to the severity that would warrant full replacement — that level of discoloration is common in normal high-mileage clutch wear.

32. B — An oil filter with lower flow capacity than specified restricts the volume of oil that can pass through the filter media at any given time. [D] When engine RPM increases and the pump pushes more oil volume than the undersized filter can pass, the filter's bypass valve opens to prevent starvation. While bypass prevents total oil starvation, the bypassed oil is unfiltered — it carries abrasive particles that circulate through the bearings. Over two oil change intervals (10,000+ miles), this repeated exposure to unfiltered, particle-laden oil accelerates bearing surface wear.

33. C — Air trapped during the initial fill expanded as the engine reached full highway operating temperature, pushing coolant through the radiator cap into the overflow tank. [D] When the engine cooled, the coolant should have been drawn back from the overflow by the cap's vacuum valve. If the vacuum valve is stuck closed, the coolant remains in the overflow and cannot return — the radiator and engine are now low on coolant. On the next highway drive, the reduced coolant volume cannot absorb the heat load, and the engine overheats. Bleeding the air and verifying the cap's vacuum valve resolves both issues.

34. A — Both technicians correctly describe the measurement locations for determining cylinder bore taper. [C] Taper is the difference between the largest and smallest bore diameter measurements taken in the same direction at different heights. The largest measurement is taken at the top of ring travel where wear is greatest (the rings reverse direction and dwell longest), and the smallest is taken at the bottom of ring travel where wear is least (minimal ring contact time and lower combustion pressure). The difference between these two measurements equals the taper.

35. D — When the oil pan is dented inward by road debris, the primary concern beyond the visible crack is the relationship between the dented pan and the oil pump pickup tube and screen assembly that sits inside the pan. [D] The dent may have pushed the pan floor upward into direct contact with the pickup, bending the tube, displacing the screen from its correct position, or crushing the screen against the pump body. Even if the crack is repaired, a displaced pickup that no longer sits at the correct depth in the oil will cause oil starvation during driving conditions.

36. B — The colleague is correct: the oil pump is a positive-displacement device that generates pressure and flow based on the rotation of its internal gears or rotors — it does not have a timing relationship that affects its function. [D] The drive gear indexing determines the rotational alignment between the pump shaft and its drive source, but since the pump produces pressure equally at all rotational positions, being one tooth off does not alter oil delivery. On engines where the oil pump drive also drives the distributor, the indexing affects ignition timing — but the pump itself works normally regardless.

37. C — A radiator that contains clean, correct-color coolant while the overflow tank contains darker, differently colored coolant with an oily sheen suggests the overflow tank holds old coolant from a different service that was never fully exchanged. [A] During typical coolant services, some shops drain and refill the radiator without draining the overflow tank. Over multiple services with different coolant types, the tank accumulates a mixture of old coolants that degrades to a dark, discolored fluid. The oily sheen may be from coolant additive breakdown products. Draining, cleaning, and refilling the overflow tank resolves the appearance discrepancy.

38. A — All findings converge on worn main bearings: a deep rhythmic thud from the lower engine that does not change with single-cylinder disable (main bearings support all cylinders), oil pressure at the absolute minimum specification at hot idle (excessive clearance allowing maximum oil leakage), and a thud that diminishes but persists at higher RPM as increased pump output partially compensates. [D] The 10 PSI hot idle reading — sitting exactly at the minimum — means any further wear will push the pressure below specification, signaling imminent bearing failure.

39. D — All available diagnostic tests have been performed by multiple technicians and all confirm normal engine operation. [A] The oil consumption rate of one quart per 2,500 miles falls within the manufacturer's published acceptable range. The technician should clearly explain to the customer that the consumption rate is within the manufacturer's design parameters for this specific engine, that all diagnostic tests confirm no defect exists, and that vehicle-to-vehicle variation in oil consumption exists even among the same manufacturer's products.

40. B — An intake manifold bolt that bottoms out in its hole before the manifold is fully seated indicates the bolt is longer than the available thread depth in the hole — the bolt tip contacts the bottom of the hole before the head can clamp the manifold. [A] Intake manifold bolts are often different lengths for different positions depending on the casting thickness at each bolt location. The technician must verify the correct bolt length for each specific position using the manufacturer's bolt location diagram. Installing a bolt that is too long damages the threads and prevents proper clamping.

41. A — An engine with 60,000 miles and no previous problems that sat for three months in a cold garage and now shows universally low compression (50–70 PSI) on all cylinders is experiencing stuck piston rings. [C] During extended storage, especially in humid or cold conditions, moisture condenses on the cylinder walls and ring surfaces. Combined with the varnish that forms from stale oil, the moisture causes the rings to stick in their grooves. Stuck rings cannot expand against the bore wall, and compression bypasses the ring pack freely. Extended cranking with oil-treated cylinders may free the rings, or the engine may require disassembly.

42. C — A single main bearing bore that measures 0.003 inches larger than all others — with the correct cap in the correct position — indicates damage has occurred at that specific location. [C] The most likely cause is a previous bearing failure at the number 2 position where the bearing spun in the bore, generating extreme heat and mechanical friction that enlarged the bore beyond its original dimension. The damaged bore must be corrected by align boring or line honing the entire main bore set to restore alignment and roundness.

43. D — Zero compression on all four cylinders with the engine cranking freely points to a complete loss of valve operation — the pistons are moving but the valves are not opening and closing. [A] The most likely cause is a broken timing belt that has stopped the camshaft while the crankshaft continues to rotate. The technician should remove the timing cover to visually inspect the belt, or simply observe whether the camshaft rotates when the crankshaft is turned. If the camshaft does not rotate, the belt is broken or has stripped its teeth.

44. B — A valvetrain tick on a specific cylinder of an OHV engine that can be temporarily silenced by rocker arm adjustment but returns within an hour indicates the hydraulic lifter at that position cannot maintain its oil charge. [B] When the rocker arm is adjusted, the lifter temporarily pumps up to zero lash. But the internal check valve leak allows oil to escape from the high-pressure chamber faster than the oil supply refills it, and the lifter collapses — recreating the clearance and the tick. The lifter has an internal defect and must be replaced.

45. C — The hot idle pressure of 12 PSI exceeds the 10 PSI minimum specification. [A] However, the 2,500 RPM pressure of 38 PSI falls below the 40 PSI minimum specification — the engine does not meet specification at speed. This indicates progressive bearing wear that has advanced to the point where the pump cannot overcome the leakage at higher flow demands. The technician should honestly inform the customer that the engine is below specification at speed, the wear will continue, and bearing failure timing is unpredictable — it could be 5,000 miles or 30,000.

46. A — Both technicians are correct. [E] Technician A correctly explains the consequence: compression rings have a tapered face designed to scrape oil downward on the downstroke. Installed upside down, the taper reverses direction and pumps oil upward into the combustion chamber, producing heavy oil consumption and blue smoke. Technician B correctly identifies the prevention method: piston rings are marked with a dot, the word "TOP," or a dimple on the side that must face the combustion chamber during installation.

47. D — Air escaping from one affected cylinder's spark plug hole during a leak-down test on the adjacent affected cylinder confirms a direct communication path between the two combustion chambers through the head gasket. [A] The loud snap the customer heard was the gasket failing under pressure.

The breach allows compression from each cylinder to leak into the other during its compression and power strokes, producing catastrophically low compression on both cylinders. The rhythmic vacuum fluctuation corresponds to both affected cylinders' combined misfires.

48. B — The oil system pre-primed successfully to 40 PSI, confirming the pump, galleries, and bearings are assembled correctly and free of blockage. [D] The critically low pressure during actual running (15 PSI idle, 20 PSI at speed) despite successful pre-priming points to the oil pressure relief valve — if the spring was left out or installed incorrectly during assembly, the valve cannot resist oil flow and dumps oil back to the pan at all pressures. During slow pre-priming with a drill, the low flow rate may produce adequate pressure, but the higher flow of the running engine overwhelms the unregulated valve.

49. A — A single weekly exhaust backfire during highway driving with no stored codes and normal mechanical tests points to an intermittent ignition misfire that allows a single cylinder's unburned fuel charge to reach the hot exhaust system and detonate. [E] At highway speed, exhaust temperatures are at their highest, providing ample heat to ignite the unburned fuel. The sporadic nature of the misfire — approximately once per week — explains why no misfire code is stored (the PCM requires a threshold number of misfires within a defined window to set a code). A marginal ignition coil, spark plug, or connection that fails intermittently under heat soak is the most likely source.

50. C — A comprehensive road test under varied real-world conditions is the single most thorough final verification because it exercises every engine system under the actual operating conditions the vehicle will encounter in daily use. [A] Cold start tests enrichment and lifter fill. Warm-up tests thermostat and cooling progression. Idle tests base compression and oil pressure. Cruise tests sustained operation and charging. Full acceleration tests maximum cylinder pressure. Deceleration tests valve sealing under high vacuum. Hill climbing tests maximum sustained load. No single bench test replicates this complete spectrum.