PRACTICE EXAM 18: ASE A1 ENGINE REPAIR SIMULATION (50 QUESTIONS)

1. A technician is diagnosing a V8 engine with a rough idle. A relative compression test using a starter current clamp and oscilloscope shows seven cylinders with nearly identical current spike amplitudes. Cylinder 6 shows a spike approximately 25% lower than the others. A standard compression test shows cylinder 6 at 142 PSI while all others are between 150 and 162 PSI. The specification minimum is 140 PSI. The cylinder 6 reading passes the standard test. Which of the following BEST explains why the relative compression test detected an issue the standard test did not?

A. The standard compression test is inherently inaccurate and should be replaced by the relative test in all diagnostic situations

B. The relative test detected an ignition problem on cylinder 6 that does not affect compression readings

C. The relative test compares cylinders directly to each other and is more sensitive to small differences — a 25% relative deviation reveals a marginal cylinder that still passes the absolute minimum threshold

D. The standard test was performed incorrectly and should be repeated with a different gauge for validation

2. A customer reports that the engine runs perfectly except for a brief hesitation that occurs approximately 5 seconds after every cold start. The hesitation lasts less than one second and does not recur. No codes are stored. All engine mechanical tests are normal. Fuel pressure is correct. The condition occurs identically on every cold start — both warm and cold mornings. Which of the following is the MOST likely cause?

A. The PCM transitions from open-loop cold-start enrichment to closed-loop fuel control at approximately 5 seconds, and the momentary fuel trim correction produces a brief lean stumble before stabilizing

B. The fuel pump loses prime during the key-off period and takes 5 seconds to fully repressurize the rail

C. The VVT system transitions from its default cold-start position to the commanded warm-idle position at 5 seconds

D. The EVAP purge valve briefly opens during the cold-start sequence and introduces a vapor bolus that enriches the mixture

3. A rebuilt engine develops an intermittent oil pressure drop of 8 to 10 PSI at hot idle that occurs only during sustained right-hand turns. The pressure recovers immediately when the vehicle straightens. Oil level is at the full mark. The oil pan is a standard stamped steel design with no internal baffles. Which of the following is the MOST likely cause?

A. A worn main bearing on the right side of the engine that opens up under the G-force of right turns

B. The oil pressure sending unit has a loose connection that shorts momentarily during the turning motion

C. The oil pump gears shift laterally inside the pump housing during the turning force and momentarily lose efficiency

D. The oil pickup tube screen is positioned such that oil sloshing to the left side of the unbaffled pan during right turns uncovers the screen and the pump draws air

4. A technician is measuring crankshaft end play on a rebuilt engine. The specification is 0.002 to 0.010 inches. The dial indicator reads 0.015 inches. The thrust bearing was verified as the correct part number during assembly. Which of the following is the MOST likely cause of the excessive end play despite the correct bearing?

A. The crankshaft thrust journal surfaces are worn beyond specification and the new thrust bearing cannot compensate

B. The thrust bearing was installed correctly but the crankshaft's thrust surfaces have worn from a previous overheating event, widening the gap beyond what a standard-thickness bearing can fill

C. The main cap bolts at the thrust bearing position were undertorqued during assembly

D. The crankshaft has axial runout that falsely inflates the end play reading on the dial indicator

5. A six-cylinder engine with 200,000 miles produces a vacuum gauge reading of 14 in. Hg at sea level — steady with no fluctuation. Compression readings are all between 112 and 120 PSI. The specification is 145 to 165 PSI. A wet test improves all cylinders by 22 to 28 PSI. Oil pressure is 14 PSI at hot idle with a specification minimum of 12 PSI. Oil consumption is one quart every 1,200 miles. The engine does not knock. The customer asks the technician for an honest assessment of the engine's remaining useful life. Which of the following is the MOST accurate response?

A. The engine will fail catastrophically within 5,000 miles because oil pressure is near the minimum threshold

B. The engine requires immediate rebuilding because compression is uniformly below specification on all cylinders

C. The engine is significantly worn throughout but has not yet reached catastrophic failure — how long it continues to function depends on driving conditions, oil change discipline, and the customer's tolerance for declining performance

D. The engine is in acceptable condition for its mileage and no action is needed because all parameters are above minimum specification

6. Technician A says that during a leak-down test, the piston must be positioned at exactly TDC on the compression stroke to ensure both valves are closed. Technician B says that if the piston is positioned a few degrees past TDC, the compression stroke transitions to the power stroke and the results are still valid because both valves remain closed. Who is correct?

A. Both Technician A and Technician B

B. Technician A only

C. Technician B only

D. Neither Technician A nor Technician B

7. A customer brings in a vehicle reporting that after driving through a construction zone on a dusty gravel road for 10 miles, the engine developed a ticking noise from the valvetrain area that has persisted for the past 500 miles. The air filter appears excessively dirty — significantly more than expected for the service interval. Oil analysis shows elevated silicon levels. Which of the following is the MOST likely chain of events?

A. The dust contaminated the fuel system and the ticking is from fuel injector damage on one or more cylinders

B. The dusty conditions caused the serpentine belt to slip and the ticking is from a belt-driven accessory bearing

C. The extreme dust load exceeded the air filter's capacity and fine dust particles bypassed the filter into the engine, contaminating the oil and causing accelerated wear on the valvetrain components

D. Fine dust particles were drawn through the breather system past the air filter, entered the crankcase oil, circulated through the oil system, and caused accelerated wear on the hydraulic lifter check valves and cam lobe surfaces

8. A technician is rebuilding an engine and discovers that one of the pistons has the wrist pin bore offset to one side — the pin bore is not centered between the piston skirt faces. The pin bore is 0.040 inches closer to one side than the other. Which of the following is the significance of this offset?

A. The piston is defective and was manufactured with an off-center pin bore that will cause a connecting rod alignment problem

B. The offset pin bore is a designed feature that reduces piston slap noise by controlling which direction the piston rocks at the crossover points of each stroke

C. The offset pin bore compensates for uneven cylinder bore wear and should be oriented toward the thrust side

D. The offset is a weight-reduction feature that has no functional significance for piston orientation

9. A rebuilt engine has been running for 2,000 miles with no issues. The customer returns reporting that the engine has developed a persistent sweet smell from under the hood. The temperature gauge reads normal. The coolant level in the overflow tank has dropped slightly. The engine oil is clean. No white smoke is visible from the exhaust. A block test at idle and at 2,500 RPM is negative. A cooling system pressure test holds at 16 PSI for 30 minutes. Which of the following should the technician investigate NEXT?

A. The head gaskets for a very small breach that is below the detection threshold of both the block test and pressure test

B. The intake manifold gasket for a coolant seep at one of the coolant crossover passages that drips onto the hot exhaust manifold and vaporizes

C. Add UV dye to the coolant and drive for 200 miles, then inspect all cooling system components, engine surfaces, and the ground under the vehicle with UV light to locate the leak source

D. Replace the radiator cap because a stuck vacuum valve could be venting coolant vapor under certain conditions

10. A technician discovers during an engine teardown that the crankshaft main bearing caps have been numbered with paint pen by a previous technician. The original factory stampings are no longer visible due to corrosion. The technician must verify that the paint pen numbers are correct before reassembly. Which of the following is the MOST reliable method to verify cap position?

A. Trial-fit each cap to each saddle position — the correct cap should seat flush against its saddle with no rocking, and the bore should be round when measured with the cap torqued to specification

B. Measure the cap bolt hole spacing on each cap and match it to the corresponding saddle spacing

C. Match the bearing wear patterns on each cap to the corresponding journal wear pattern

D. Weigh each cap on a precision scale and install them in ascending weight order from front to rear

11. A four-cylinder engine with a timing belt develops a sudden misfire on cylinders 1 and 4 simultaneously. Compression on cylinders 1 and 4 is 50 PSI each. Cylinders 2 and 3 are at 155 PSI — within specification. The engine is an interference design. A leak-down test on cylinder 1 shows 45% leakage with air at the tailpipe. Cylinder 4 shows 48% leakage with air at the intake. Which of the following BEST explains why the air exits at different locations on the two affected cylinders?

A. Cylinders 1 and 4 have different head gasket failures — one to the exhaust port and one to the intake port

B. The timing belt jumped teeth, bending an exhaust valve on cylinder 1 and an intake valve on cylinder 4 because they were at different points in their valve timing cycles when the belt jumped

C. The head gasket failed between both cylinders and a shared coolant passage, creating cross-leak paths

D. The spark plugs on cylinders 1 and 4 are loose and leaking compression through different port pathways

12. A customer reports that the engine temperature gauge surges upward briefly when the vehicle comes to a stop after sustained highway driving, then slowly drops back to normal within 60 seconds of idling. The cooling fan activates when the temperature rises. The coolant level is correct. No codes are stored. Which of the following BEST explains this brief temperature surge?

A. The radiator has a partial restriction that causes uneven coolant flow during the transition from highway to idle

B. The thermostat is sticking closed momentarily when the coolant flow rate drops from highway speed to idle

C. The water pump impeller has a cavitation problem that temporarily disrupts flow during the RPM change

D. At highway speed, ram airflow through the radiator supplements the cooling capacity — when the vehicle stops, the sudden loss of ram air allows a brief temperature rise until the electric fan compensates

13. Technician A says that a piston ring end gap that is too small can cause the ring ends to butt together as the ring expands from heat during operation, which can score the cylinder bore or break the ring. Technician B says that a piston ring end gap that is too large allows excessive blowby and oil consumption from the oversized gap. 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

14. A rebuilt engine produces a clicking noise from the front of the engine that tracks with crankshaft speed — one click per revolution. The noise is present at all temperatures and all RPMs. The technician removes the serpentine belt and the noise persists. The timing cover is intact. The harmonic balancer appears properly installed and the bolt is torqued to specification. Which of the following should the technician investigate?

A. A loose flywheel bolt at the rear of the crankshaft that produces a click transmitted through the crank to the front

B. A timing chain link that is catching on a worn guide or sprocket tooth once per revolution inside the cover

C. The crankshaft keyway for a damaged or missing Woodruff key that allows the harmonic balancer to shift once per revolution

D. A broken engine mount bracket that produces a click as the engine rocks once per crankshaft revolution

15. A V6 engine with 175,000 miles has been running with a known oil consumption issue — one quart every 800 miles. The customer has been monitoring and adding oil regularly. The engine has no knocking, no misfires, and no performance complaints. During a routine oil change, the technician discovers that the oil drained from the engine has a distinctly unusual odor — not the typical petroleum smell, but a sharp, acrid chemical smell. The oil color is normal dark brown. Which of the following is the MOST likely cause of the unusual odor?

A. The oil has been contaminated with transmission fluid from a leaking oil cooler that shares a housing with the transmission cooler

B. The oil has absorbed an abnormally high concentration of combustion byproducts — sulfur compounds, acids, and carbon — from the excessive blowby caused by the worn rings

C. The oil has been contaminated with coolant that entered through a minor internal gasket seep

D. The customer has been adding a different oil brand at each top-off and the mixed additive packages have produced the chemical odor

16. A technician is diagnosing an engine with a P0300 (random misfire) code. The misfire occurs at idle and light load but clears above 2,000 RPM. A compression test shows all six cylinders within specification and within 5% of each other. Fuel trims are plus 22% on both banks. A vacuum gauge reads a steady 15 in. Hg — lower than the expected 17 to 21 range. The PCV system is functional. Which of the following is the MOST likely cause?

A. Multiple worn valve guides on both banks that allow oil past the stems and disrupt combustion at idle

B. A camshaft with multiple lobes slightly below specification that reduces valve lift enough to affect idle but is compensated at higher RPM

C. A failing fuel pump that cannot maintain pressure during the low-demand conditions of idle despite meeting specification during cranking

D. A significant vacuum leak that introduces unmetered air — causing the elevated fuel trims, reduced vacuum, and lean misfires that clear above 2,000 RPM when the proportional effect diminishes

17. A freshly rebuilt engine is being started for the first time. The technician pre-primed the oil system to 45 PSI. The engine starts and runs at 1,500 RPM on the fast-idle cam. Oil pressure shows 50 PSI. After 60 seconds, the technician checks the exhaust by feeling each header tube. All four tubes are hot and pulsing evenly. However, the technician notices a thin, steady stream of white vapor rising from the valve cover area — not from the exhaust. The vapor has a faint sweet smell. Which of the following is the MOST likely cause?

A. Coolant is weeping from beneath the valve cover onto a hot engine surface — likely from a coolant passage near the valve cover gasket area that was not properly sealed during assembly

B. Assembly lubricant on the valve cover exterior is burning off as the engine reaches operating temperature for the first time

C. The valve cover gasket was installed incorrectly and oil is seeping onto the exhaust manifold and vaporizing

D. Condensation from the coolant passages inside the head is evaporating through the valve cover breather opening

18. A customer's engine has been diagnosed with worn piston rings on all four cylinders. The engine has 195,000 miles. The customer asks whether replacing only the piston rings — without boring or replacing the pistons — would be an effective repair. Which of the following is the MOST accurate response?

A. Replacing rings in worn bores rarely produces satisfactory results because the new rings cannot conform to the worn bore profile — the taper, out-of-round, and glazed surface of the existing bores prevent the new rings from sealing properly

B. Ring replacement alone is always effective regardless of bore condition because new rings are designed to seat against any surface

C. Ring-only replacement is the standard repair for worn rings and boring is only needed if the bores have scoring or cracking

D. The customer should be advised to simply switch to a heavier oil rather than performing any ring repair on a 195,000-mile engine

19. A technician is performing a cranking vacuum test on an engine that will not start. The vacuum gauge reads a steady 3 in. Hg during cranking. This is within the normal cranking vacuum range of 1 to 4 in. Hg. However, the engine has fuel, spark, and cranks at normal speed. Compression readings are: Cyl 1 = 55, Cyl 2 = 50, Cyl 3 = 58, Cyl 4 = 52. The specification is 145 to 160 PSI. Which of the following BEST reconciles the normal cranking vacuum with the extremely low compression?

A. The cranking vacuum is produced by the pistons drawing air through the intake — even with low compression, the intake valves open and close and the pistons still move air through the engine, producing vacuum despite the charge not being retained during compression

B. The vacuum gauge is malfunctioning and reading a false normal value despite the engine's severe internal damage

C. The low compression is caused by a fuel system problem that is washing the cylinder walls and the cranking vacuum is unaffected by fuel delivery issues

D. The compression gauge is reading incorrectly and should be replaced before any further diagnosis is performed

20. A technician discovers during a rebuild that the engine block's main oil gallery has a slight bend in its bore at the midpoint — the gallery is not perfectly straight from front to rear. A gallery brush can be pushed through with moderate effort but catches slightly at the bend. Which of the following is the correct action?

A. Drill out the gallery bore to the next larger size to straighten the passage and improve oil flow

B. Work the gallery brush back and forth with cleaning solvent until the brush passes freely, then flush the gallery thoroughly to remove all debris

C. The gallery bend will restrict oil flow to the rear bearings and the block must be replaced

D. Install a sleeve inside the gallery to create a smooth internal passage through the bend area

21. A customer reports that the engine has a persistent rough idle that appeared after an intake manifold gasket replacement performed at another shop. The idle is rough with plus 18% long-term fuel trim on bank 1 and plus 3% on bank 2. A smoke test reveals no visible smoke from any gasket surface, hose connection, or vacuum port. Compression is within specification on all cylinders. Which of the following should the technician investigate despite the negative smoke test?

A. The fuel injectors on bank 1 for contamination that may have occurred during the manifold service

B. The bank 1 oxygen sensor for damage that occurred during the manifold removal and reinstallation

C. The intake manifold bolts on bank 1 for correct torque — a bolt that was not fully tightened may allow a leak too small for the smoke test

D. The intake manifold gasket orientation — some manifolds have asymmetric gaskets that can be installed upside down, partially blocking a port on bank 1 while bank 2 seals correctly

22. A rebuilt engine exhibits a condition where the oil level drops one quart in 500 miles but there is zero visible exhaust smoke at any condition, no external leaks, and the PCV system is functional. Compression is within specification. Oil pressure is normal. A UV dye test after 200 miles shows no external fluorescence anywhere on the engine, undercarriage, or ground. Which of the following is the MOST likely explanation for the invisible oil consumption?

A. The oil is being consumed through the breather system at a rate too low to produce visible vapor in the engine compartment

B. A very small oil leak exists that the UV dye has not yet reached because the leak is in a pressurized gallery that only flows during operation

C. The catalytic converter is oxidizing the oil vapor in the exhaust stream before it exits the tailpipe as visible smoke — the oil is being burned in the combustion chambers but the converter eliminates the visual evidence

D. The oil level measurement is inaccurate because the dipstick tube is routed through a hot area that thins the oil and produces a false low reading

23. A technician is performing a valve job on a four-cylinder DOHC head. After cutting all seats and lapping all valves, the technician performs a vacuum test on each port — applying vacuum to the port with the valve seated and measuring how long the vacuum holds. Seven of the eight valves hold vacuum for over 60 seconds. The number 2 intake valve drops from 20 in. Hg to 15 in. Hg in 30 seconds. Which of the following is the MOST appropriate action?

A. Reinstall the valve because 15 in. Hg after 30 seconds represents an acceptable seal for normal operation

B. Relap the number 2 intake valve to its seat with additional compound and retest — the seat contact may have a small imperfection that additional lapping can correct

C. Recut the number 2 intake valve seat because the lapping has been unsuccessful in creating an adequate seal

D. Replace the number 2 intake valve because the valve face must have a defect that prevents proper seating

24. A vehicle with a turbocharged engine develops a check engine light with codes P0299 (turbo underboost) and P0234 (turbo overboost). Both codes are stored within 100 miles of each other. The customer reports that boost pressure seems inconsistent — sometimes the engine feels powerful and sometimes it feels sluggish. The wastegate actuator rod moves freely. Which of the following is the MOST likely cause of both intermittent under boost and over boost conditions?

A. The wastegate valve is sticking — sometimes stuck open (causing under boost) and sometimes stuck closed (causing overboost) from carbon buildup on the valve and seat

B. The turbocharger bearings are failing and the shaft wobbles between efficient and inefficient positions

C. The boost pressure sensor is intermittently reading high and low, causing the PCM to alternately reduce and increase boost

D. The intercooler is partially restricted and unpredictably fluctuates between allowing and blocking charge air flow

25. A technician is inspecting a crankshaft removed from a V8 engine with 250,000 miles. All main and rod journal measurements are within the standard specification — no undersizing has ever been performed. The journal surfaces are smooth with no scoring. However, Magnaflux inspection reveals a very small indication — barely visible under the magnetic particles — at the fillet radius of the number 5 rod journal. The indication is less than 0.25 inches long. Which of the following is the correct action?

A. Polish the fillet radius to remove any surface stress and reinstall the crankshaft since all measurements pass

B. Regrind the number 5 rod journal to remove the indication through material reduction below the crack depth

C. The indication is within the acceptable size range for a high-mileage crankshaft and can be monitored

D. Replace the crankshaft because any Magnaflux indication at a fillet radius — regardless of size — represents a fatigue crack that will propagate under continued cyclic loading

26. An engine block is being prepared for a rebuild. The technician hot-tanks the block, installs all gallery plugs and freeze plugs, and then pressurizes the oil galleries with shop air to check for leaks. Air can be heard escaping from inside the number 4 cylinder bore. No air escapes from any other bore or any external surface. Which of the following is the MOST likely source of the air leak?

A. A gallery plug in the number 4 area was not fully seated and air is escaping through the partially sealed plug

B. The block has a casting porosity defect between the oil gallery and the number 4 cylinder bore wall

C. A crack exists between the main oil gallery and the number 4 cylinder bore that allows pressurized air to pass through the block wall into the bore

D. The number 4 cam bearing oil hole is misaligned and is allowing air to travel from the gallery through the cam bearing bore to the cylinder

27. A rebuilt engine has been running for 10,000 miles. The customer brings it in for a routine oil change. The technician tests oil pressure: hot idle = 20 PSI (specification minimum 15), hot 2,500 RPM = 44 PSI (specification 40 to 65). At the 500-mile service, readings were 30 PSI idle and 56 PSI at speed. At the 5,000-mile service, readings were 24 PSI idle and 48 PSI at speed. Which of the following BEST characterizes the overall pressure trend across all three service intervals?

A. The rate of pressure decrease is decelerating — the drop from 500 to 5,000 miles (6 PSI idle, 8 speed) was larger than the drop from 5,000 to 10,000 miles (4 PSI idle, 4 speed) — indicating the bearings are stabilizing after initial break-in wear and all readings remain within specification

B. The 10 PSI total idle pressure drop from 30 to 20 over 10,000 miles indicates accelerating wear

C. The speed pressure dropping from 56 to 44 PSI indicates the oil pump is failing prematurely

D. The pressure at both idle and speed should have increased as the rings seated, not decreased

28. A customer reports that the engine makes a single brief metallic snap from the top of the engine on the first cold start each morning. The sound does not repeat and the engine runs normally afterward. The sound has been present for 20,000 miles without change. No codes are stored. Oil level and pressure are correct. Which of the following is the MOST likely cause?

A. A timing chain tensioner that resets its ratchet position on the first oil pressure event of each start

B. A VVT cam phaser locking pin that engages or disengages as oil pressure establishes phaser control on the first start revolution

C. A hydraulic lifter that has fully collapsed overnight and produces a single snap as the cam lobe pushes it to full extension on the first revolution

D. A loose rocker arm that produces a single impact against the valve stem tip before the lifter pumps up on the first revolution

29. A technician discovers during an engine rebuild that one connecting rod has a visibly different color than the other three — it has a blue-purple heat discoloration along its beam. The rod came from the cylinder that had the bearing failure being repaired. The rod journal on the crankshaft is scored but repairable. The rod itself shows no visible cracks, and the big-end bore measures within specification when the cap is torqued. Which of the following is the correct action?

A. Install the rod as-is because it passes dimensional inspection and the discoloration is cosmetic

B. Magnaflux the rod to check for hidden fatigue cracks — if it passes, it can be reused after verifying the bore roundness

C. Replace all four connecting rods as a matched set because mixing heat-treated and non-heat-treated rods creates imbalance

D. Replace the discolored rod because the heat from the bearing failure has likely altered the metallurgical properties of the rod material, reducing its fatigue strength even if no cracks are currently visible

30. A vehicle owner reports that the engine has developed a gradual increase in blow-by vapor visible at the oil filler cap opening over the past 30,000 miles. The engine has 180,000 miles. Compression is uniformly low at 115 to 122 PSI (specification 145 to 165). Oil consumption is one quart every 1,500 miles. Oil pressure is 16 PSI at hot idle (specification minimum 12). The engine does not knock. A crankcase pressure test shows 2.5 inches of water column — the specification maximum is 3.0. Which of the following MOST accurately describes this engine?

A. The crankcase pressure exceeding specification confirms a PCV system failure that is the primary cause of the blowby

B. The engine has a cracked block that is allowing external air into the crankcase and producing the visible vapor

C. The engine has generalized ring and bore wear producing the progressively increasing blowby, low compression, and oil consumption — all findings are consistent and the crankcase pressure is approaching but still within specification

D. The engine requires immediate attention because the combination of low compression and approaching-maximum crankcase pressure indicates imminent piston ring failure

31. A rebuilt engine is being pre-primed with a drill-driven priming tool. The technician observes that oil pressure builds to 40 PSI on the gauge and oil flows from all rocker arm assemblies under the valve cover. However, the technician notices that one of the four piston cooling jets (oil squirters) does not spray — the other three produce a steady stream. The non-spraying jet has been verified as clean and correctly aimed. Which of the following is the MOST likely cause?

A. The oil gallery passage feeding that specific jet has a blockage — likely debris or dried sealant from the assembly process that was not removed during block cleaning

B. The jet's internal check valve is stuck closed from a manufacturing defect in the new replacement jet

C. The pre-prime pressure of 40 PSI is below the jet's activation threshold and it will spray at the higher pressures of a running engine

D. The jet is installed backwards and is spraying oil into the gallery instead of out toward the piston

32. A customer reports that the engine temperature gauge fluctuates between normal and slightly above normal in a rhythmic cycle of approximately 45 seconds per full oscillation during highway driving. Coolant level is correct. The system holds pressure. A block test is negative. The thermostat has been replaced and bench-tested — it opens at the correct temperature. The technician bleeds the cooling system multiple times but the oscillation persists. Which of the following is the MOST likely remaining cause?

A. The water pump impeller has a loose blade that intermittently disrupts coolant flow

B. The new thermostat is cycling between open and closed from a marginally weak wax element

C. An air pocket trapped in a location that the standard bleed procedure cannot reach — such as inside the heater core or a high point in the engine's coolant jacket

D. The radiator has a partially collapsed internal baffle that creates a pulsating coolant flow pattern

33. A technician is diagnosing a V8 engine where the customer complains of a ticking noise that is only audible from inside the cabin with the windows up and the radio off. The noise is not audible from under the hood with the engine running. The noise tracks with engine RPM. Which of the following is the MOST likely source?

A. A small exhaust leak at a gasket or connection point that is too quiet to hear in the noisy engine compartment but resonates through the vehicle's body structure into the cabin

B. A hydraulic lifter with a marginal check valve leak that produces a tick too faint for external detection

C. A slight exhaust leak at the exhaust manifold-to-head gasket that produces a high-frequency tick conducted through the vehicle's exhaust hangers and body mounts into the cabin

D. An intake manifold runner vibration at engine frequency that transmits through the firewall into the cabin

34. A rebuilt engine has been running perfectly for 15,000 miles. The customer returns stating that the engine now hesitates briefly when first starting in the morning — it takes approximately 3 seconds of cranking before the engine catches. Once started, the engine runs perfectly all day with immediate restarts. This condition has developed gradually over the past month. Which of the following is the MOST likely cause?

A. The timing chain has stretched enough in 15,000 miles to retard the cam timing and affect cold-start combustion

B. The fuel system is losing pressure overnight through a leaking injector or a failing fuel pump check valve, requiring extended cranking to repressurize the rail before the engine can start

C. The spark plugs have worn enough in 15,000 miles to require higher voltage for cold ignition and the coils cannot produce adequate voltage during cranking

D. The coolant temperature sensor has drifted and is reporting a warmer temperature than actual, causing the PCM to deliver insufficient cold-start enrichment

35. Technician A says that an aluminum cylinder head expands more than a cast iron engine block when heated to operating temperature, and this differential expansion must be accounted for in the head gasket design. Technician B says that the head bolts on an aluminum head/cast iron block engine are under more clamping stress variation during heat cycling than on an engine where both the head and block are the same material. 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

36. A customer reports that the engine oil turns very dark within 500 miles of every oil change. The engine has 160,000 miles. No misfires, codes, or performance issues are present. Oil analysis shows normal wear metal levels, no coolant contamination, and no fuel dilution. The only abnormal finding is elevated soot content compared to the typical range for this engine type. Which of the following BEST explains the elevated soot and rapid oil darkening?

A. The oil filter is the wrong application and is not filtering particulates effectively from the circulating oil

B. The engine has worn valve stem seals that are allowing oil into the combustion chambers, where it burns incompletely

C. The oil brand being used has a weak dispersant additive package that cannot keep soot in suspension effectively

D. The worn piston rings allow excessive blowby that forces combustion soot past the rings into the crankcase oil at a rate higher than a new engine would produce

37. A technician is measuring valve spring free height on a set of 16 valve springs removed during a head reconditioning. Twelve springs measure within 0.020 inches of each other (1.880 to 1.900 inches). Four springs measure significantly shorter — 1.820 to 1.840 inches. The minimum free height specification is 1.860 inches. Which of the following is the correct action?

A. Replace all 16 springs as a complete set because the variation between springs indicates the entire set has deteriorated unevenly

B. Replace only the four short springs with new springs that meet specification and reinstall the twelve that are within specification

C. The four short springs have taken a permanent set and must be replaced — they can no longer produce adequate closing force at the designed installed height

D. Shim the four short springs to increase their installed pressure to compensate for the lost free height

38. A rebuilt engine has been running for 500 miles. During the break-in oil change, the technician cuts open the oil filter and finds a small but identifiable piece of RTV silicone sealant — approximately 1/4 inch in size — stuck to the filter media. No other abnormal debris is found. Oil pressure and engine sound are normal. Which of the following is the correct interpretation?

A. The RTV piece was likely a small excess from an assembly joint that broke free during initial operation and was captured by the filter — this is a common break-in finding that does not indicate a problem as long as oil pressure is normal and no further debris appears

B. The RTV indicates a gasket failure is developing and the engine should be torn down to identify the source

C. The RTV indicates the block oil galleries were not properly cleaned before assembly and more debris is likely trapped inside

D. The RTV may have originated from the oil pump housing gasket and indicates the pump was assembled with sealant instead of the specified dry gasket

39. A technician discovers that a V6 engine block has a main bearing bore alignment problem — the bores do not form a straight line from front to rear. The misalignment measures 0.002 inches at the center bore. The maximum specification is 0.001 inches. Which of the following is the correct repair?

A. Replace the block because main bore misalignment cannot be corrected without specialized equipment

B. The block must be align-honed or align-bored to restore all main bearing bores to a single straight centerline

C. Install thicker bearing shells at the center position to compensate for the misalignment offset

D. The 0.002-inch misalignment is close enough to specification that standard bearings will compensate

40. A customer reports that the engine produces a brief puff of blue smoke from the exhaust approximately 10 seconds after a cold start every morning. The smoke does not reappear during the drive to work (15 minutes) or during any other driving condition during the day. Oil consumption is

approximately one quart every 4,000 miles. Compression is within specification on all cylinders. Which of the following is the MOST likely cause?

A. Worn piston rings that only leak oil during the cold-start condition when thermal clearances are widest

B. The PCV valve is sticking open during the cold-start enrichment period and pulling excess oil vapor into the intake

C. A small amount of oil leaking past the turbocharger seals during the first few seconds of operation before the seals warm and expand

D. Worn valve stem seals that allow oil to pool on the closed valve faces overnight and burn off when the engine starts

41. A technician is diagnosing an engine noise that the customer describes as a "chirping" sound from the timing chain cover area. The chirp occurs once per camshaft revolution and increases in frequency with RPM. The timing chain, tensioner, and guides were replaced 10,000 miles ago. Oil level and pressure are correct. Which of the following is the MOST likely cause?

A. A timing chain guide that has developed a worn groove where the chain rides and produces a chirp as each link exits the groove

B. The timing chain was installed with a sprocket that has a slightly chipped tooth — the chain link chirps as it passes over the defect once per revolution

C. The tensioner ratchet mechanism is clicking as it adjusts on each revolution due to a manufacturing defect

D. A cracked timing cover that flexes slightly under the tension of the chain and produces a chirp at chain frequency

42. A technician is diagnosing a cooling system that loses approximately one quart of coolant every three weeks. The only visible evidence is a small, dried white crystalline residue on the threads of one of the heater hose fittings at the firewall. No dripping has ever been observed. A pressure test holds at specification. Which of the following is the correct interpretation?

A. The crystalline residue is mineral deposits from the water supply and is unrelated to the coolant loss

B. The residue confirms that coolant is seeping from the heater hose fitting at a rate consistent with the reported loss, but the seep is too slow to drip — it evaporates and leaves the residue

C. The white residue indicates the heater hose fitting threads are corroded and the entire fitting must be replaced

D. The pressure test holding at specification rules out the fitting as the leak source despite the visible residue

43. A technician is rebuilding a high-mileage engine and must decide whether to replace the timing chain. The current chain measures 0.5 inches longer than a new chain when both are stretched to their maximum length. There are no specifications available for maximum chain stretch. Which of the following is the correct decision?

A. Replace the timing chain, sprockets, tensioner, and guides as a complete set because the 0.5-inch stretch represents significant wear that will only worsen and the cost of the components is trivial relative to the total rebuild expense

B. Install the existing chain because timing chains stretch gradually and 0.5 inches may be within acceptable limits

C. Replace only the chain and reuse the sprockets because sprocket wear is negligible compared to chain wear

D. Measure the chain stretch as a percentage of total chain length — if less than 2%, the chain is reusable

44. A rebuilt engine develops an oil leak at the timing cover gasket within the first 1,000 miles. The technician who built the engine used RTV sealant on the timing cover per the manufacturer's instructions. Upon removing the cover, the technician discovers that the RTV bead was applied too thick in one area — the excess sealant was squeezed into the oil gallery opening when the cover was installed and partially blocked the gallery. Which of the following is the MOST significant consequence of this sealant intrusion?

A. The blocked gallery reduced oil flow to the timing chain and tensioner, potentially causing accelerated chain wear

B. The excess sealant blocked the gallery completely and the engine ran with no oil to the valvetrain for 1,000 miles

C. The sealant pieces will eventually break free and circulate through the oil system, potentially blocking other passages or bearing oil holes

D. The sealant intrusion into the oil gallery reduced oil flow to downstream components and created debris that can circulate and block other oil passages — both the immediate flow restriction and the downstream contamination risk are concerns

45. A customer brings in a vehicle where the engine has been running on only seven of eight cylinders for the past 2,000 miles. The number 3 spark plug was found to be completely fouled and the customer has been too busy to address it. Beyond replacing the fouled plug, which of the following should the technician check for additional damage from the extended single-cylinder misfire?

A. The number 3 piston for thermal damage from running without combustion for 2,000 miles

B. The catalytic converter on the bank containing cylinder 3 for damage from the unburned fuel that passed through the dead cylinder into the exhaust for 2,000 miles

C. The crankshaft bearings for damage from the vibration imbalance of running on seven cylinders

D. The flywheel for warpage from the uneven torque pulses of seven-cylinder operation

46. A technician is performing a final quality inspection on a rebuilt engine. All standard tests have passed. The technician performs one additional check: with the engine at operating temperature and idling, the technician opens the oil filler cap and holds a piece of cardboard over the opening. The cardboard is gently sucked against the opening and held there by vacuum. Which of the following does this result indicate?

A. The engine has excessive blowby that is creating positive crankcase pressure and pushing the cardboard away

B. The PCV system is malfunctioning and creating excessive vacuum in the crankcase that could pull oil past the seals

C. The PCV system is functioning correctly — the slight crankcase vacuum is the expected result of a properly working PCV system on an engine with good ring seal

D. The result is inconclusive because the test cannot distinguish between PCV vacuum and external air infiltration

47. A rebuilt engine is started for the first time and oil pressure reaches 55 PSI within 2 seconds. The engine runs smoothly. After 5 minutes at 1,500 RPM, the technician reduces idle to 750 RPM. The oil pressure at 750 RPM reads 22 PSI — within the 20 PSI minimum specification. The technician is

concerned because at the same idle speed during pre-priming with the drill, the gauge showed 40 PSI. Which of the following explains the pressure difference between pre-priming and running idle?

A. During pre-priming, the cold thick oil produced artificially high readings — the running engine has warmed the oil to operating viscosity, which flows more easily through the clearances and produces lower but normal pressure readings

B. The oil pump has already worn during the first 5 minutes of operation and needs replacement

C. The pre-prime pressure was artificially high because the relief valve was stuck closed during priming

D. The bearings have already worn during break-in and the clearances have increased significantly in 5 minutes

48. A technician discovers that a V8 engine has been assembled with one connecting rod bearing installed without the locating tang seated in its notch. The engine has been running for 200 miles with no symptoms — normal oil pressure, no knocking, and no performance issues. Which of the following is the correct action?

A. Continue running the engine because the bearing has seated in its current position and disturbing it now would be more harmful

B. Monitor oil pressure at each oil change and address the bearing only if pressure begins to decline

C. The unsecured bearing will eventually shift and is at high risk of catastrophic failure — replace the bearing immediately

D. The bearing must be removed, properly seated with the tang in its notch, and clearance rechecked — an untanged bearing can rotate in the bore, blocking the oil hole and causing sudden bearing failure at any time

49. A customer reports that the engine runs perfectly during the day but develops a slight rough idle every evening after the vehicle has been driven for more than two hours in bumper-to-bumper traffic on hot days. The rough idle clears within minutes of reaching highway speed. No codes are stored. Compression is within specification. Which of the following is the MOST likely cause?

A. The catalytic converter becomes heat-saturated from extended idle operation and creates back-pressure that disrupts the idle mixture

B. A heat-related component failure — such as an ignition coil, sensor, or connector — that develops increased resistance when heat-soaked after extended idle in traffic and recovers when highway airflow cools the engine compartment

C. The engine develops slight detonation from heat soak after extended idle that the knock sensor manages at cruise but cannot control at idle

D. The PCV valve becomes stuck from heat expansion after extended idle and disrupts crankcase ventilation

50. A technician has completed a comprehensive engine rebuild and has verified all quality checks at both the 500-mile and 5,000-mile service intervals. The engine has performed flawlessly. The customer asks when the engine should be considered fully broken in and operating at its long-term baseline condition. Which of the following is the MOST accurate answer?

A. The engine is fully broken in after the first 500 miles once the initial oil change removes break-in contaminants

B. Most rebuilt engines reach their long-term baseline operating condition between 5,000 and 10,000 miles — the period during which ring seating completes, bearing surfaces establish their final running clearances, and oil pressure stabilizes at its post-break-in level

C. The engine is never fully broken in because wear is a continuous process that begins the moment the engine first starts

D. The engine reaches its peak performance at 2,500 miles and gradually declines from that point forward

Practice Exam 18: 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. C — The standard compression test measures absolute pressure against a fixed minimum threshold — cylinder 6 at 142 PSI passes the 140 PSI minimum. [A] The relative compression test compares each cylinder's cranking resistance directly against the others in the same engine, making it far more sensitive to small differences. A 25% lower current spike on cylinder 6 means the starter encounters significantly less resistance on that cylinder's compression stroke compared to the others — revealing a marginal cylinder that technically "passes" the absolute test but is clearly the weakest link in the engine.

2. A — A brief stumble that occurs at exactly the same point (approximately 5 seconds) after every start — regardless of ambient temperature — is consistent with a programmed PCM control transition. [A] During the first few seconds after start, the PCM operates in open-loop mode using a pre-programmed fuel map. At approximately 5 seconds (varying by manufacturer), the PCM transitions to closed-loop, where it begins adjusting fuel delivery based on oxygen sensor feedback. This transition momentarily leans or enriches the mixture as the system recalibrates, producing the brief stumble before steady-state closed-loop control is achieved.

3. D — Oil pressure that drops specifically during sustained right turns in an engine with an unbaffled oil pan is the classic presentation of oil sloshing away from the pickup tube. [D] During a right turn, lateral G-force pushes the oil to the left side of the pan. Without internal baffles to contain the oil near the pickup, the screen is exposed to air, and the pump momentarily draws air instead of oil. The pressure drops until the vehicle straightens and the oil returns to cover the pickup. An aftermarket baffled pan or windage tray would prevent this condition.

4. B — End play of 0.015 inches with the correct thrust bearing part number means the bearing is the right thickness but the crankshaft's thrust journal surfaces (the flat faces on the crankshaft that the bearing flanges contact) have worn from a previous overheating event or excessive axial loading. [C] The worn thrust surfaces on the crankshaft create a wider gap than the standard bearing can fill. The repair requires either an oversize thrust bearing with thicker flanges to compensate for the worn crankshaft surfaces, or crankshaft replacement if the wear is too severe for an oversize bearing.

5. C — This engine has uniformly low compression (ring wear confirmed by wet test), oil consumption, oil pressure approaching minimum specification, and no knocking — all consistent with a high-mileage engine that is significantly worn but has not yet reached catastrophic failure. [A] The honest assessment is that the engine's remaining life is unpredictable — it depends on driving habits, oil change discipline, and whether the customer can tolerate the declining performance, increasing oil consumption, and risk of eventual bearing or ring failure. Some engines in this condition last another 50,000 miles; others fail within 10,000.

6. A — Both technicians are correct. [A] Technician A correctly states the critical requirement: the piston must be at TDC on the compression stroke to ensure both valves are fully closed — this is the only position where the leak-down test measures only ring, valve, and gasket sealing. Technician B correctly notes that moving a few degrees past TDC transitions into the power stroke, but both valves remain closed throughout the power stroke, so the test conditions are still valid as long as the piston has not moved so far that valve events begin.

---

7. D — The chain of events begins with the extreme dust load exceeding the air filter's capacity — fine particles bypass the saturated filter element and enter the engine through the intake. [A] However, these particles primarily contaminate the oil (confirmed by elevated silicon in the oil analysis) rather than directly damaging the combustion components. The contaminated oil circulates through the entire lubrication system, and the abrasive dust particles accelerate wear on precision components — particularly hydraulic lifter check valves, cam follower surfaces, and cam lobes — producing the persistent valvetrain ticking.

---

8. B — A piston with an intentionally offset wrist pin bore is a designed feature found on many modern engines. [C] The offset positions the pin bore slightly toward the major thrust side of the piston. This design controls the direction of piston rock at the crossover points (TDC and BDC) where the connecting rod changes its angular direction. By biasing the pin toward the thrust side, the piston's rocking motion is directed against the thrust surface in a controlled manner that reduces the audible slap noise. The offset direction determines the correct piston orientation during installation.

9. C — A sweet smell from the engine compartment, a slight coolant level drop, clean oil, no white smoke, and negative block and pressure tests indicate a very small external coolant seep that is vaporizing on a hot surface before it can drip. [D] Adding UV dye to the coolant and driving for 200 miles allows the fluorescent dye to concentrate at the leak source. Under UV light inspection, even a microscopic seep that evaporates on contact will leave a fluorescent residue trail at its origin point — revealing leaks too small for pressure testing or visual inspection to detect.

10. A — When factory stampings are no longer visible and only paint pen markings remain, the markings cannot be trusted without verification. [C] The most reliable method is trial-fitting each cap to each saddle position: the correct cap seats flush against its saddle with no rocking or misalignment, and when torqued to specification, the bore measures round. An incorrect cap in a position will rock, sit

unevenly, or produce an out-of-round bore measurement. This physical fit verification is more reliable than any marking or indirect measurement.

11. B — When a timing belt jumps teeth on an interference engine, different cylinders are at different points in their firing cycle at the moment the belt jumps. [A] Cylinder 1 may have had its exhaust valve open (or nearly open) at the moment the timing shifted, and the piston struck and bent that exhaust valve. Cylinder 4 may have had its intake valve in a vulnerable position, bending the intake valve instead. The different leak paths (exhaust on cylinder 1, intake on cylinder 4) directly correspond to which valve was in the wrong position on each cylinder when the belt jumped.

12. D — At highway speed, the ram air forced through the radiator by the vehicle's forward motion significantly supplements the cooling fan's capacity — providing substantial additional heat rejection. [D] When the vehicle stops in traffic, this ram airflow ceases immediately. The engine still contains the accumulated heat from highway operation, and the electric fan alone must now handle the entire cooling load. The brief delay between the loss of ram air and the fan's full compensation allows the temperature to spike momentarily before the fan brings it back under control.

13. A — Both technicians are correct. [C] Technician A correctly identifies the danger of insufficient end gap: as the ring heats and expands during operation, the ends grow toward each other. If the gap is too small, the ends butt together, and the ring has nowhere to expand. The resulting force can score the cylinder bore or fracture the ring. Technician B correctly identifies the consequence of excessive end gap: the oversized opening allows combustion gas to blow past the ring gap (blowby) and allows oil to pass upward through the gap into the combustion chamber.

14. C — A clicking noise once per crankshaft revolution at all temperatures and speeds, persisting with the serpentine belt removed, eliminates all accessories and narrows the source to the crankshaft assembly itself. [E] The most likely cause is a damaged or missing Woodruff key in the crankshaft keyway that allows the harmonic balancer to shift slightly once per revolution. The key locates the balancer in a fixed rotational position on the crankshaft — if the key is damaged, sheared, or missing, the balancer can rock or rotate slightly with each revolution, producing the rhythmic click.

15. B — An engine with worn rings that produces excessive blowby forces a higher-than-normal volume of combustion byproducts — sulfur compounds, nitrogen oxides, partially burned hydrocarbons, and acidic gases — past the rings into the crankcase oil. [D] These combustion byproducts are absorbed by the oil's additive package. Over time, the concentration of these corrosive compounds exceeds what the oil's neutralizing additives can buffer, producing the sharp, acrid chemical odor that is distinctly different from the normal petroleum smell of clean or even normally dirty engine oil.

16. D — A P0300 random misfire at idle with plus 22% fuel trim on both banks, reduced vacuum (15 versus 17–21 in. Hg), normal compression, and a functional PCV system points to a significant vacuum leak introducing unmetered air. [A] The elevated fuel trim on both banks confirms the PCM is adding 22% more fuel to compensate for the lean condition. The reduced vacuum directly results from the atmospheric air entering the manifold through the leak. At idle, the leak's proportional effect on the air-fuel mixture is greatest, causing the random misfires. Above 2,000 RPM, the increased total airflow volume dilutes the leak's proportional impact.

17. A — White vapor with a sweet smell rising from the valve cover area — not from the exhaust — on a freshly started rebuilt engine indicates coolant is reaching a hot surface near the valve cover. [E] The most likely source is a coolant passage near the valve cover gasket area (such as a coolant crossover passage in the cylinder head) that was not properly sealed during assembly. The coolant weeps onto the hot head or valve cover surface and vaporizes, producing the sweet-smelling white steam. Assembly lubricant burning off produces an acrid chemical smell, not a sweet one.

18. C — Replacing rings in worn bores is rarely effective because the new rings are manufactured to a perfect cylindrical profile, but the worn bores have taper, out-of-round, and a glazed surface that the new rings cannot conform to. [C] The taper means the ring fits differently at the top and bottom of its travel. The out-of-round means the ring cannot maintain uniform contact around the circumference. The glazed surface lacks the crosshatch needed for ring seating. Effective ring replacement requires boring to oversize and honing to restore a true, properly finished bore.

19. A — The cranking vacuum of 3 in. Hg falls within the normal 1 to 4 range because the vacuum is produced by the pistons drawing air through the intake system during their downward travel — the intake valves open, the piston descends, and air flows through the manifold. [A] This process occurs regardless of whether the charge is subsequently retained during the compression stroke. The extremely low compression (50–58 PSI) indicates the charge is not being sealed during compression — likely from severely mistimed valves or massive ring failure — but the intake stroke still produces the vacuum that the gauge measures.

20. B — A slight bend in the main oil gallery bore is a common characteristic of production engine block casting and machining. [D] The gallery is gun-drilled during manufacturing, and minor deviations from perfectly straight are within normal production tolerances. If a gallery brush passes through with moderate effort after working back and forth with cleaning solvent, the passage is clear and functional. Thorough flushing after cleaning removes all loosened debris. The slight bend does not restrict oil flow enough to affect bearing supply under normal operating conditions.

21. D — A plus 18% fuel trim on bank 1 with plus 3% on bank 2 after an intake manifold gasket replacement, with a negative smoke test, suggests a gasket sealing issue that the smoke test cannot detect. [A] Some intake manifold gaskets have asymmetric designs — different port sizes, coolant passage locations, or vacuum channel routing on each side. If the gasket was installed upside down or rotated 180 degrees, it may seal correctly on bank 2 but partially block or misalign a port or passage on bank 1, creating an airflow or vacuum distribution problem that affects only that bank.

22. C — One quart of oil consumed per 500 miles with zero visible smoke, no external leaks, no UV dye evidence, and normal PCV function is explained by the catalytic converter's ability to oxidize the small volume of oil hydrocarbons in the exhaust before they exit the tailpipe. [D] The oil is being burned in the combustion chambers — passing through minor ring bypass, valve guide clearance, or PCV oil vapor — but the converter's extreme operating temperature (1,200°F+) destroys the visible evidence. This is a well-documented phenomenon that explains many "invisible" oil consumption complaints.

23. B — A valve that drops from 20 to 15 in. Hg in 30 seconds has a minor seat imperfection that can potentially be corrected by additional lapping. [B] The vacuum test is a sensitive final check after the seat has been cut and the valve lapped. A slight leak that loses 5 in. Hg in 30 seconds is often caused by a small imperfection in the contact ring — a microscopic high spot or debris particle — that additional lapping with fine compound can correct. If relapping does not improve the result, the seat should be recut.

24. A — A wastegate that produces both underboost and overboost conditions intermittently points to a mechanical binding problem that causes the valve to stick in different positions at different times. [A] Carbon and soot buildup on the wastegate valve and its seat — a common condition on turbocharged engines — creates a sticky valve that sometimes jams open (diverting exhaust and causing underboost) and sometimes jams closed (trapping exhaust and causing overboost). The actuator rod moving freely confirms the problem is at the valve itself, not the actuator mechanism.

25. D — Any Magnaflux indication at a crankshaft fillet radius — the transition zone between the journal surface and the counterweight — represents a fatigue crack regardless of its size. [C] Fillet radii are the highest-stress points on the crankshaft where bending and torsional loads concentrate during every crankshaft revolution. A crack at this location — even one barely visible under magnetic particles — will inevitably propagate under continued cyclic loading. Crankshaft fatigue failures are sudden and catastrophic. The crankshaft must be replaced.

26. C — Air escaping from inside the number 4 cylinder bore when the oil galleries are pressurized with shop air confirms a direct pathway between the main oil gallery and the cylinder bore. [C] The most likely cause is a crack in the block wall between the oil gallery passage and the number 4 bore. During

engine operation, this crack would allow pressurized oil to leak into the combustion chamber of cylinder 4, causing oil consumption and potentially fouling the spark plug. The block must be replaced or the crack repaired before the engine can be assembled.

27. A — The pressure decrease rate is decelerating: from 500 to 5,000 miles, idle pressure dropped 6 PSI (30 to 24) and speed dropped 8 PSI (56 to 48). [D] From 5,000 to 10,000 miles, idle dropped only 4 PSI (24 to 20) and speed dropped only 4 PSI (48 to 44). The slowing rate of decrease confirms the bearing surfaces are approaching their equilibrium running clearances after the initial break-in wear period. All current readings remain within specification. This is the normal, expected pressure trajectory of a properly rebuilt engine.

28. B — A single metallic snap on the first cold start that has been stable for 20,000 miles without change, with no codes and normal oil pressure, is consistent with a VVT cam phaser locking pin event. [B] Many VVT phasers have a spring-loaded locking pin that locks the phaser in a default position when oil pressure is absent (engine off). On the first start, as oil pressure builds and the PCM commands the phaser to move, the locking pin retracts — producing a single snap as it releases. The sound occurs once because the pin stays retracted as long as oil pressure is maintained.

29. D — A connecting rod with visible blue-purple heat discoloration from a bearing failure has been exposed to temperatures that alter the metallurgical properties of the steel. [C] The heat from the bearing failure may have reduced the rod's temper (hardness and fatigue resistance) even though the rod passes dimensional inspection and shows no visible cracks currently. Under the millions of cyclic loading events the rod will experience during continued engine operation, the weakened metallurgy becomes a preferential site for fatigue crack initiation. The discolored rod must be replaced.

30. C — All findings form a consistent picture of generalized ring and bore wear: gradually increasing visible blowby at the oil filler, uniformly low compression with wet test confirmation, moderate oil consumption, and oil pressure above minimum but trending downward. [A] The crankcase pressure of 2.5 inches of water column is approaching but still within the 3.0-inch maximum specification — further confirming that the blowby is increasing but has not yet exceeded the PCV system's venting capacity. This is a high-mileage engine aging consistently, with no single catastrophic failure.

31. A — Three of four piston cooling jets spraying while one remains dry during pre-priming — with the dry jet verified as clean and correctly aimed — isolates the problem to the oil supply path feeding that specific jet. [D] The most likely cause is a blockage in the oil gallery passage between the main gallery and the jet's feed point. Debris from the assembly process (gasket material, dried sealant, metal shavings, or cleaning solvent residue) can lodge in the small-diameter gallery passage and completely block oil flow to that jet. The passage must be cleared before the engine is started.

32. C — A persistent temperature oscillation despite thermostat replacement, bench-testing verification, and multiple bleeding attempts points to a trapped air pocket in a location the standard bleed procedure cannot reach. [D] Some engine cooling jackets have high points — near the heater core, at the back of the cylinder head, or in coolant crossover passages — where air can become trapped and resist standard bleeding. As the pocket circulates past the temperature sensor, it produces the rhythmic temperature reading change. Elevated bleeding methods (vacuum-fill systems, higher bleed points, or running with the front of the vehicle elevated) may reach the trapped pocket.

33. C — A ticking noise that tracks with engine RPM but is audible only inside the cabin — not from under the hood — indicates the sound is being conducted through the vehicle's structure rather than through the air. [E] A small exhaust leak at the exhaust manifold-to-head gasket produces a high-frequency tick that is too quiet to hear in the noisy engine compartment but is efficiently conducted through the exhaust manifold bolts to the head, through the head to the block, through the engine mounts to the subframe, and through the body mounts into the cabin. The vehicle's structure acts as a sound conductor.

34. B — A gradually developing extended-crank cold-start condition — taking 3 seconds instead of the normal immediate start — that has worsened over the past month points to a fuel system component that is progressively failing to maintain fuel rail pressure during overnight sitting periods. [E] A fuel pump check valve that is gradually losing its seal, or a fuel injector that is developing a slow drip, allows fuel pressure to bleed down overnight. Each morning, the pump must repressurize the empty or partially empty rail before the injectors can deliver adequate fuel for starting. The progressive worsening matches the gradual deterioration of the leaking component.

35. A — Both technicians are correct. [A] Technician A correctly identifies the fundamental thermal property difference: aluminum expands approximately twice as much as cast iron for the same temperature increase. An aluminum head on a cast iron block will grow more than the block during heat-up, creating differential movement that the gasket must accommodate. Technician B correctly identifies the consequence for the head bolts: the differential expansion creates cyclic stress variation on the bolts that is greater than on an engine where both components expand at the same rate.

36. D — Worn piston rings allow excessive blowby — combustion gas that bypasses the ring pack into the crankcase. [D] This blowby gas carries combustion soot particles directly into the crankcase oil. On an engine with good ring seal, only a small amount of blowby enters the crankcase. On an engine with worn rings, the increased blowby volume delivers significantly more soot to the oil, overwhelming the dispersant additive package faster and causing the oil to darken rapidly. The elevated soot in the oil analysis confirms this mechanism.

37. A — Four valve springs measuring 1.820 to 1.840 inches — well below the 1.860-inch minimum specification — have taken a permanent set and cannot produce adequate closing force at any installed height. [B] Springs that have lost 0.040 to 0.060 inches of free height have suffered metallurgical fatigue that reduces their spring rate permanently. Shimming cannot restore the lost spring rate — it only increases installed compression by moving the spring to a shorter installed height, but the weakened spring still produces less force per inch of compression than a spring with correct free height. All four must be replaced.

38. A — A single small piece of RTV sealant found in the oil filter during a 500-mile break-in oil change, with normal oil pressure and no other debris, is a common and benign break-in finding. [D] During assembly, small amounts of excess RTV at gasket joints can squeeze into oil passages. During the first minutes of operation, oil flow dislodges these small pieces and carries them to the filter. The filter captures them exactly as designed. As long as oil pressure is normal and no metallic debris accompanies the sealant, this is a one-time event that does not indicate a developing problem.

39. B — Main bearing bore misalignment of 0.002 inches — double the 0.001-inch maximum specification — means the bearing bores do not form a straight line. [C] A crankshaft installed in misaligned bores will experience bending stress at every revolution as it deflects through the offset center bore. This cyclic bending accelerates bearing wear, increases friction, and can eventually fatigue-crack the crankshaft. The block must be align-honed or align-bored to restore all main bores to a single, straight centerline before assembly.

40. D — A brief puff of blue smoke approximately 10 seconds after every cold start that does not reappear during driving, with minimal oil consumption and normal compression, is the classic presentation of worn valve stem seals. [A] While the engine sits overnight, oil from the valve cover area seeps past the worn seals and pools on the closed valve faces. On the first start, the pooled oil is drawn into the combustion chamber during the first few intake events and burns, producing the visible blue puff. The 10-second delay corresponds to the time needed for the initial oil pool to burn off. The smoke does not recur because the dynamic seal during running is adequate.

41. B — A chirping noise from the timing chain area that occurs once per camshaft revolution (once per two crankshaft revolutions) and increases with RPM, appearing 10,000 miles after a timing chain replacement, points to a sprocket defect. [B] A chipped tooth on a camshaft or crankshaft sprocket produces a single chirp as the chain link passes over the defect once per sprocket revolution. The regular once-per-cam-revolution frequency distinguishes it from a tensioner issue (which would be more random) or a guide issue (which would produce a continuous rubbing sound).

42. C — White crystalline residue on the threads of a coolant fitting is the telltale signature of a slow coolant seep — the coolant weeps through the threads, evaporates on the hot surface, and leaves behind the mineral and additive deposits as a white crystalline residue. [D] A pressure test may hold specification because the seep is so slow that the coolant loss over the 20-minute test period is below the gauge's detection threshold. However, over three weeks of driving — hundreds of heat cycles that pressurize and depressurize the system — the cumulative loss equals the reported one quart. Tightening the fitting or applying thread sealant resolves the leak.

43. A — During a comprehensive engine rebuild, all timing components should be replaced as a set — chain, sprockets, tensioner, and guides — regardless of measured stretch. [A] The cost of these components is trivial relative to the total rebuild expense, and installing a worn chain in a freshly rebuilt engine guarantees the timing system will be the first component to require service. A chain with 0.5 inches of measured stretch has clearly reached the end of its service life and would produce retarded valve timing and progressively worsening performance if reinstalled.

44. D — An excessively thick RTV sealant bead that was squeezed into the oil gallery opening creates two simultaneous problems. [D] First, the sealant partially blocking the gallery immediately restricts oil flow to all components downstream of the blockage — timing chain, tensioner, and potentially the valvetrain. Second, as the engine runs and oil circulates at operating pressure and temperature, pieces of the sealant will eventually break free and travel through the oil system as debris, potentially blocking other oil passages or becoming embedded in bearing surfaces elsewhere in the engine.

45. B — Running an engine for 2,000 miles with a dead cylinder sends unburned fuel from that cylinder's intake charge directly through the exhaust into the catalytic converter. [E] The converter attempts to oxidize this raw fuel, generating extreme internal temperatures that can melt the ceramic substrate, collapse the internal structure, and destroy the converter's ability to function. The converter on the affected bank should be inspected for substrate damage, efficiency tested with a scan tool (upstream vs. downstream O2 comparison), and replaced if the catalyst has been compromised.

46. C — A piece of cardboard gently sucked against the oil filler opening by vacuum confirms the PCV system is creating the designed slight negative pressure in the crankcase. [A] The PCV valve draws metered airflow from the crankcase into the intake manifold, and if the engine's ring seal is good (minimal blowby), the volume of air drawn out by the PCV exceeds the volume of blowby entering the crankcase, creating a net slight vacuum. This is the expected result on a properly rebuilt engine with good ring seal and a functioning PCV system.

47. A — During pre-priming with a drill-driven tool, the oil was cold (high viscosity) and the drill rotated the pump much slower than the crankshaft drives it during running operation. [D] Cold, thick oil

flowing slowly through the tight clearances of a freshly assembled engine produces artificially high pressure readings on the gauge. After 5 minutes of running, the oil has reached operating temperature and thinned to its designed viscosity, and the thinner oil flows much more easily through the bearing clearances — producing the lower but entirely normal hot idle pressure of 22 PSI. The difference is entirely explained by the viscosity change.

48. D — A connecting rod bearing installed without the locating tang seated in its notch is not positionally secured in the rod bore. [C] The tang's sole purpose is to prevent the bearing shell from rotating in the bore during operation. Without the tang engaged, the bearing can rotate — and if it rotates even slightly, the oil feed hole in the bearing moves out of alignment with the rod's oil supply passage. The moment the oil hole is blocked, that journal is instantly starved of lubrication, and the bearing surface is destroyed within seconds. The bearing must be corrected immediately.

49. B — An engine that develops rough idle only after extended hot-idle operation in traffic — and recovers when highway airflow cools the engine compartment — exhibits a classic heat-soak-related intermittent failure. [A] Ignition coils, crankshaft or camshaft position sensors, or wiring connectors that have marginal insulation or slightly corroded contacts can develop increased electrical resistance when heat-soaked from extended idle in traffic. The increased resistance causes intermittent signal errors that disrupt ignition timing or fuel delivery just enough to produce rough idle. Highway airflow cools the component below its failure temperature and normal operation resumes.

50. B — Most rebuilt engines complete the active break-in process — ring seating, bearing surface burnishing, gasket settling, and thermal cycling stabilization — between 5,000 and 10,000 miles. [D] During this period, oil pressure stabilizes at its post-break-in level (the rate of pressure decrease from initial readings decelerates and plateaus), compression may increase slightly as rings fully seat, and oil consumption typically decreases to its long-term baseline rate. After 10,000 miles with stable readings, the engine has established its long-term operating condition and can be serviced on normal intervals.