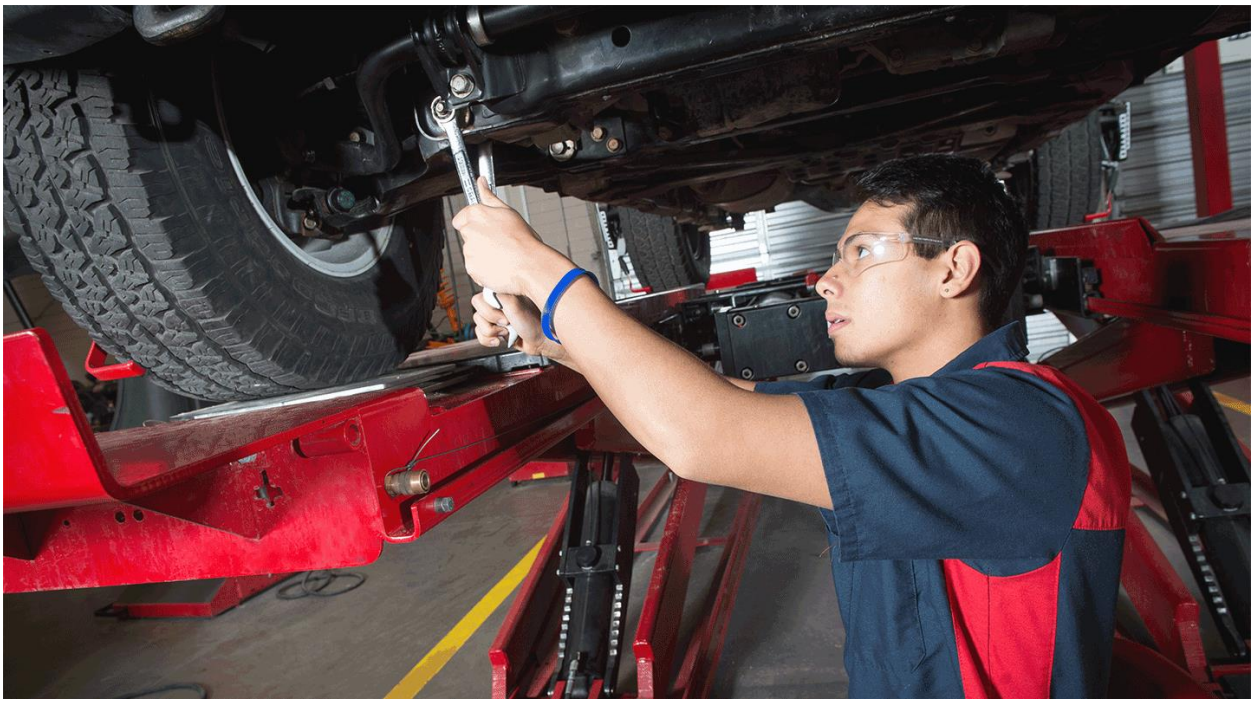
Entry-Level Certification Program



ASE Study Guide

For the Automobile

Entry-Level Certification Tests

ASE Study Guide for the Automobile Entry-Level Certification Tests

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Test specifications effective 7/1/2023

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Overview

Introduction

This study guide is designed to help students prepare for the ASE Entry-Level tests. This guide contains detailed information about these tests which cover technology found in most of today's automobiles, sport utility vehicles, and light trucks. The task list for each test, found in the following pages, should help you review your technical knowledge. Your focus should be on less familiar topics. This should make it easier to select additional reference materials that will help you prepare for your test(s).

ASE's Entry-Level certification helps students prove their abilities to themselves, to their instructors, and to their prospective employers. By passing the tests, you will earn the most valuable credential available to automotive, truck, and collision repair students. Because the tests are challenging, you'll have the satisfaction of knowing you are among the best-prepared students for the workforce. What's more, these credentials are recognized throughout the U.S. The Entry-Level certifications are your first step toward becoming an ASE-certified technician.

Certified technicians promote customer trust and improve the image of the industry. And trust and professionalism are the first steps to a better, more prosperous business. ASE encourages you to take the tests and to join the proven pros who wear the ASE Blue Seal of Excellence®.

How Do I Become Certified?

For the ASE Entry-Level certification program, there are ten tests in the Auto series, five tests in the Medium/Heavy Truck Series, and four tests in the Collision Repair & Refinish series. If you pass one or more test(s), you will become certified as an ASE Entry-Level Technician.

ASE Entry-Level Certification credentials are valid for two years. If you continue your career in automotive service, within two years you should be ready to continue to the ASE Professional level certification tests.

Who Writes the Questions?

Working professionals from the service industry and instructors with expertise in the test topic write the questions, which are entirely job-related. The questions are designed to test knowledge of the skills that you need to know in servicing automobiles.

Each question has its roots in an ASE "item-writing" workshop where working technicians, service representatives from automobile manufacturers (domestic and import), aftermarket parts and equipment manufacturers and technical educators meet to share ideas and translate them into test questions. Each question written must survive review by all members of the group. The questions are written to mirror practical problems relevant to the diagnosis and repair performed by technicians in their day-to-day work.

After being written, all questions are pre-tested and quality-checked on a national sample of students. Those questions meeting ASE standards of quality and accuracy are then included in the scored sections of the tests; those that do not are redrafted or discarded altogether.

Are the Tests Hard to Pass?

The tests cover technical concepts that entry-level technicians need to know for success on the job. The good news is that these are the same tasks that are part of every ASE accredited training program, so you should be covering most of them in your class and lab work.

When you review the test specifications for the tests (included later in this guide), you will see that the passing score for most of the tests is 50% to 60% correct to pass. This does NOT mean that the tests are easy to pass. In fact, the tests are carefully constructed with questions that vary from fairly easy to quite difficult. As a result, the passing score is specifically set to identify the more knowledgeable students who should pass vs. the less knowledgeable ones who should not pass. In this case, the relatively low passing score indicates that the test is pretty challenging overall. That is why it is important to know what to expect and study before taking the test, so you can do your very best.

If you pass, you should be proud – you have demonstrated understanding and knowledge that meets tough industry standards. If you do not pass, you shouldn't feel bad – the tests are tough and not everyone passes. You can retake a test that you failed 30 days or more after your first attempt, and that gives you time to review your score report and focus additional study on the areas of the test where you didn't score well.

Instructors and administrators who want to learn more about the construction of the tests and proper interpretation of the test scores should review the "Guide for Interpreting Results and Technical Data for the ASE Entry-Level Certification Tests", available at www.ase.com/entry-level.

How Do I Prepare for the ASE Entry-Level Tests?

The most important thing you can do is become familiar with test content and question formats.

The Test Specifications in this guide describe the content covered by each test. The Task Lists detail the actual tasks studied by students in each specialty area. Together, these are the blueprint for writing and assembling the ASE Entry-Level tests.

Each question on the test relates to a particular task or set of tasks in the task list. Therefore, review the task list, thinking about whether you know how to perform each task listed.

All questions are multiple-choice. The sample questions in this study guide are examples of the three types of questions on the test. Note there are different instructions for some question types.

Read each question carefully so that you understand exactly what is being asked. Each question tests a specific diagnostic or repair problem and has only one correct answer.

To summarize, we suggest the following steps be taken:

Step 1. Carefully read the Test Specifications for each test you will attempt.

Step 2. Study the Task List for each area.

Step 3. Go over the sample questions to become familiar with each question type. This is very important!

Step 4. Review steps 1 through 3 and identify the skill areas where you need additional study.

Test Content and Sample Questions

To help you prepare, each section begins with the Test Specifications, which will list the main categories covered and the number of test questions, as well as the percentage of the test devoted to each topic.

The Task List describes the work activities a student should be familiar with. This list was developed by instructors, working technicians, and technical experts from across the country and will provide a valuable checklist telling you what you should know for the test.

The number of tasks listed does not equal the number of questions. Although every question relates to at least one listed task, some tasks may not appear on the test. Some complex tasks may be covered by several questions. Some questions may cover multiple simple tasks. The main goal of the list is to describe what is studied in school; any task on the list may be covered on the test.

Sample questions follow the Test Specifications and Task Lists. Although these specific questions will not appear on tests, they are in the same format as actual test questions. The ASE Entry-Level tests employ several types of multiple-choice questions. Note that some questions have special instructions, which will appear with similar questions on the ASE Entry-Level tests.

The Three Types of ASE Test Questions

ASE uses three different types of multiple-choice questions on its tests:

- Direct or Completion Questions
- Technician A / Technician B Questions
- Except or Least Likely Questions

Each question has four answer options. There is always one correct answer and three incorrect answers. Every question contains the information needed to answer it correctly. ASE does not use trick questions or questions with more than one correct answer.

Direct or Completion Questions

With this question type, you're asked a question or asked to complete a statement. Remember, all questions are based upon industry-accepted practices, and there are technical reasons why the choices are correct or incorrect.

Read the entire question carefully. Then consider each of the four answer choices and rule out the ones that you think are obviously incorrect. If you're left with two or more choices that seem plausible to you, you may be lacking a piece of knowledge that would let you rule out an incorrect answer. Choose the answer that seems most likely to you, based on your experience. If you still cannot choose an answer, take your best guess and go on. There may be a cause that's more likely than any of the choices given, but you should select the most likely of the four choices shown.

Here is an example of a Direct Question, with each answer option explained:

A 4-wheel disc brake equipped vehicle, without ABS, has a pulsation that is felt in the brake pedal whenever the brakes are applied to slow or stop the vehicle. Which of these is the most likely cause?

(A) Loose brake pad shims
(B) Uneven brake pad wear
(C) A low brake fluid level
(D) Brake rotor thickness variation

The correct answer is (D) Brake rotor thickness variation. Here is why:

Option A is incorrect. Loose brake pad shims could cause excessive braking noise, but will not cause a brake pedal pulsation.

Option B is also incorrect. Uneven brake pad wear is usually caused by problems with the caliper or mounting hardware but will not cause brake pedal pulsation.

Option C is incorrect as well. A low brake fluid level could make brake pedal application feel spongy, and may decrease stopping power, but will not cause the brake pedal pulsation.

Option D is correct. A variation in disc brake rotor thickness will force the brake pads to move in and out during brake application. This movement will be transferred to the brake pedal by the hydraulic system. Of the four choices given, this is clearly the most common concern related to brake pedal pulsation.

Technician A / Technician B Questions

The Technician A / B question is the most misunderstood ASE question format, but it can be simple to answer when approached the right way. Here is how to approach these questions: Two technicians are making independent statements which you must judge separately to be true or false. The most common mistake with this type of question is allowing one technician's statement to influence your thinking about the other's. Always keep in mind that the two technicians are not arguing with one another, they're simply making independent statements.

Use this approach: Read Technician A's statement by itself and ask yourself: Is this true or false? Then set aside Technician A's statement and consider Technician B's statement by itself. It might help to write down a T or F for Tech A, and a T or F for Tech B. If only one of the statements is true, then your answer is either A or B. If both statements are true, your answer is C. If both statements are false (and there are times when this is the case), your answer is D.

Here is an example of a Technician A / Technician B question, with the answer options explained:

The front end of a vehicle vibrates up and down while traveling at most road speeds.

Technician A says that too much radial runout of the front tires could be the cause.

Technician B says that static out-of-balance of the front tires could be the cause.

Who is right?

(A) A only
(B) B only
(C) Both A and B
(D) Neither A nor B

The correct answer is (C) Both A and B. Here is why:

First, evaluate Technician A’s statement by itself. Excessive radial runout will make the spindle move up and down, and this can cause the front end to vibrate. So Technician A's statement is true, but "A only" is not the correct answer. You must consider Technician B's statement separately before you can answer.

Second, evaluate Technician B’s statement by itself. Tires that are out of balance can cause a front end vibration, so Technician B's statement is true. But "B only" is not the correct answer. Don't compare B to A and think that since one is correct, the other must be incorrect, or think that "B only" is the correct answer because tire imbalance is more likely than too much radial runout. Remember to evaluate each statement by itself.

In this case, both statements are true – too much radial runout could cause the vibration, and bad static tire balance could also be the cause. Because both Technician A and Technician B are correct, the answer to this question is (C) Both A and B. While it may be unlikely that any vehicle will have both tire imbalance and excessive radial runout at the same time, the point of the question is to find out whether you know the various problems that can cause the problem that is being described.

Finally, the correct answer isn't (D) Neither A nor B, because both Technician A's and Technician B's statements are correct. There might be other causes for the vibration that are more common than either tire imbalance or radial runout, but you must stick to the answer choices given in the question.

Except or Least Likely Questions

This type of question usually begins with a statement of a problem or malfunction of some kind. You must choose the one thing that will NOT or is LEAST likely to cause the problem. In simple terms, this means there will be three answers that WILL cause the problem and one answer that WON'T cause the problem. You are looking for the single answer that WON'T cause the problem.

Often, the best way to find the answer to this type of question is by process of elimination. Look at each possible answer in turn and decide if it is or isn't likely to cause the problem.

Here is an example of an Except question with each answer option explained:

This question is not like the previous ones. It has the word EXCEPT. Look for the choice that could NOT cause the described situation. Read the entire question carefully before choosing your answer.

Engine detonation could be caused by any of these EXCEPT:

(A) a lean air-fuel mixture.
(B) retarded ignition timing.
(C) excessive carbon in the combustion chambers.
(D) a stuck-closed EGR valve.

Because these questions require you to look for the one incorrect choice, they always include the warning above the question, just so that you don't overlook "EXCEPT" or "LEAST LIKELY" when you read the question. The correct answer here is (B) retarded ignition timing. Here is why:

Option A is **incorrect.** A lean fuel mixture increases combustion temperature and could cause detonation. Scratch this one out. Remember, you are looking for the one answer that does not cause the problem.

Option B is **correct**. Retarded timing is the exception compared to the other choices. Since retarded timing reduces cylinder temperatures, it does not contribute to detonation. But just to be sure, go ahead and rule out the other choices.

Option C is also **incorrect**. Excessive carbon can raise the compression ratio and combustion temperature and ignite the air/fuel mixture prematurely. Any of these can result in detonation. You are looking for the answer that cannot cause detonation. So, strike this one.

Option D is **incorrect** as well. EGR flow into the combustion chamber helps to lower combustion temperatures. If the valve is stuck closed, detonation could result. Strike this one out. You need the one answer that doesn't cause detonation.

Once you have evaluated all the options and found the three choices that could cause the problem, you can be confident that you have chosen the one that could not cause it, and that one is the correct answer.

Test Taking Tips

When preparing and taking the ASE Entry-Level tests, keep these tips in mind:

- Don’t freak out – this is what you have been studying in class. If you have reviewed the task list, studied up on any tasks that you are unsure of, and practiced evaluating the different types of ASE questions, you should be well prepared to take the test.
- Every question has one single right answer, three wrong answers, and enough information to choose the right answer.
- There are no "trick" questions, so don't try to guess based on what you think the people at ASE "want" you to answer. All questions are written by industry experts and are based on actual automotive systems and repair practices. Use what you know from your own education and experience to help you select your answers.
- Read each question (including ALL of the answers) carefully, so that you understand exactly what is being asked.
- Answer the question based ONLY on the choices given. Don't try to "read into" the question or add information that is not provided.
- Don't spend too much time on any question. Some are harder than others, but they all count the same, and you pass or fail the test based on your total score.
- If you are not sure of your answer, try to eliminate as many incorrect choices as possible to narrow down your options, select the answer you think is most likely correct, and flag the question for review. If you get to the end of the test and have time left, go back and review the questions you flagged.
- You are free to change your answers but don’t doubt yourself too much; if you read the question carefully and have evaluated all the options, your first choice is usually your best choice.
- It is to your advantage to answer every question, so don't leave any answers blank. ASE test scores are based on the number of right answers you provide. A question left unanswered is scored as wrong and there is no penalty for guessing. You might get it right!

Automobile Tests – Specifications and Task Lists

There are ten tests in the ASE Entry-Level Automobile test series:

- Engine Repair (ER)
- Automatic Transmission/Transaxle (AT)
- Manual Drive Train and Axles (MD)
- Suspension and Steering (SS)
- Brakes (BR)
- Electrical/Electronic Systems (EE)
- Heating and Air Conditioning (AC)
- Engine Performance (EP)

The task lists and test specifications for these eight system-specific tests are derived directly from the 2022 Instructional Standards for ASE Automobile program accreditation at the MAST level.

- Maintenance and Light Repair (MR)
- Automobile Service Technology (AS)

The task lists and test specifications for these two comprehensive tests are derived directly from the 2022 Instructional Standards for ASE Automobile program accreditation at the MLR and AST levels, respectively.

The task lists are simply listings of the tasks involved in servicing and repair of various vehicle systems. Each question in a test is keyed to one or more of these tasks. The task lists are organized into content categories, and these content categories, along with the number of questions included in each category, comprise the test specifications. Every exam form meets these specifications.

Tests may include additional, unscored questions for statistical evaluation. Extra questions will not count for or against the final score. However, since they are not identified, students should answer every question to the best of their ability.

I. ENGINE REPAIR (ER)

Test Specification

Content Area	Questions In Test
A. General: Engine Diagnosis; Removal and Reinstallation	10
B. Cylinder Head and Valve Train D&R	10
C. Engine Block Assembly D&R	7
D. Lubrication and Cooling Systems D&R	13
Required To Pass: 22 of 40	TOTAL 40

Task List

ER-A. General: Engine Diagnosis; Removal and Reinstallation (R & R)

1. Research vehicle service information such as fluid type, internal combustion engine operation, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
3. Verify operation of the instrument panel engine warning indicators.
4. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine needed action.
5. Install engine covers using gaskets, seals, and sealers as required.
6. Verify engine mechanical timing.
7. Inspect, remove, and/or replace engine mounts.
8. Identify service precautions related to service of the internal combustion engine of a hybrid electric vehicle.
9. Remove and reinstall engine on a newer vehicle equipped with OBD; reconnect all attaching components and restore the vehicle to running condition.

ER-B. Cylinder Head and Valve Train Diagnosis and Repair

1. Identify cylinder head and valve train components and configurations.
2. Remove cylinder head; inspect gasket condition; install cylinder head and gasket; tighten according to manufacturer's specification and procedure.
3. Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition.
4. Inspect valve actuating mechanisms for wear, bending, cracks, looseness, and blocked oil passages (orifices); determine needed action.
5. Adjust valves (mechanical or hydraulic lifters).
6. Inspect and replace camshaft and drive belt/chain; includes checking drive gear wear and backlash, end play, sprocket and chain wear, overhead cam drive sprocket(s), drive belt(s), belt tension, tensioners, camshaft reluctor ring/tone-wheel, and valve timing components; verify correct camshaft timing.
7. Inspect valve springs for squareness and free height comparison; determine needed action.
8. Replace valve stem seals on an assembled engine; inspect valve spring retainers, locks/keepers, and valve lock/keeper grooves; determine needed action.

9. Inspect valve guides for wear; check valve stem-to-guide clearance; determine needed action.
10. Inspect valves and valve seats; determine needed action.
11. Check valve spring assembled height and valve stem height; determine needed action.
12. Inspect valve lifters and hydraulic lash adjusters; determine needed action.
13. Inspect and/or measure camshaft for runout, journal wear and lobe wear.
14. Inspect camshaft bearing surface for wear, damage, out-of-round, and alignment; determine needed action.

ER-C. Engine Block Assembly Diagnosis and Repair

1. Identify engine block assembly components and configurations.
2. Remove, inspect, and/or replace crankshaft vibration damper (harmonic balancer).
3. Disassemble engine block; clean and prepare components for inspection and reassembly.
4. Inspect engine block for visible cracks, passage condition, core and gallery plug condition, and surface warpage; determine needed action.
5. Inspect and measure cylinder walls/sleeves for damage, wear, and ridges; determine needed action.
6. Perform deglazing and cleaning of cylinder walls.
7. Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment; determine needed action.
8. Inspect crankshaft for straightness, journal damage, keyway damage, thrust flange and sealing surface condition, and visual surface cracks; check oil passage condition; measure end play and journal wear; check crankshaft position sensor reluctor ring (where applicable); determine needed action.
9. Inspect main and connecting rod bearings for damage and wear; determine needed action.
10. Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; determine needed action.
11. Inspect and measure piston skirts and ring lands; determine needed action.
12. Determine piston-to-bore clearance.
13. Inspect, measure, and install piston rings.
14. Inspect auxiliary shaft(s) (balance, intermediate, idler, counterbalance and/or silencer); inspect shaft(s) and support bearings for damage and wear; determine needed action; reinstall and time.
15. Assemble engine block.

ER-D. Lubrication and Cooling Systems Diagnosis and Repair

1. Identify lubrication and cooling system components and configurations.
2. Perform engine oil and filter change; use proper fluid type per manufacturer specification; reset maintenance reminder as required.
3. Perform cooling system pressure and dye tests to identify leaks; check coolant condition and level; inspect and test radiator, pressure cap, coolant recovery tank, heater core, and galley plugs; determine needed action.
4. Identify causes of engine overheating.
5. Inspect, replace, and/or adjust drive belts, tensioners, and pulleys; check pulley and belt alignment.

6. Inspect and test coolant; drain and recover coolant; flush and/or refill cooling system; use proper fluid type per manufacturer specification; bleed air as required.
7. Inspect, remove, and replace the water pump.
8. Remove, inspect, and replace thermostat and gasket/seal.
9. Remove and replace radiator.
10. Inspect and test fan(s), fan clutch (electrical or mechanical), fan shroud, and air dams; determine needed action.
11. Perform oil pressure tests; determine needed action.
12. Inspect auxiliary coolers; determine needed action.
13. Inspect, test, and/or replace oil temperature and pressure switches and sensors.
14. Inspect oil pump gears or rotors, housing, pressure relief devices, and pump drive; determine needed action.

II. AUTOMATIC TRANSMISSION AND TRANSAXLE (AT)

Test Specification

Content Area	Questions In Test
A. General: Transmission and Transaxle Diagnosis	18
B. In-Vehicle Transmission/Transaxle Maintenance and Repair	10
C. Off-Vehicle Transmission and Transaxle Repair	12
Required To Pass: 22 of 40	TOTAL 40

Task List

AT-A. General: Transmission and Transaxle Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify automatic transmission and transaxle components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle equipped with a dipstick.
5. Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle not equipped with a dipstick.
6. Diagnose transmission/transaxle gear reduction/multiplication concerns using driving, driven, and held member (power flow) principles.
7. Diagnose pressure concerns in a transmission using hydraulic principles (Pascal's Law).
8. Identify and interpret transmission/transaxle concerns, differentiate between engine performance and transmission/transaxle concerns; determine needed action.
9. Diagnose fluid loss and condition concerns; determine needed action.
10. Perform stall test; determine needed action.
11. Perform lock-up converter system tests; determine needed action.

12. Perform pressure tests on transmissions/transaxles equipped with electronic pressure control; determine needed action.
13. Diagnose electronic transmission/transaxle control systems using appropriate test equipment and service information.
14. Diagnose noise and vibration concerns; determine needed action.

AT-B. In-Vehicle Transmission/Transaxle Maintenance and Repair

1. Inspect, adjust, and/or replace external manual valve shift linkage, transmission range sensor/switch, and/or park/neutral position switch.
2. Drain and replace fluid and filter(s); use proper fluid type per manufacturer specification.
3. Perform relearn procedures.
4. Inspect, replace/or and align powertrain mounts.
5. Inspect for leakage; replace external seals, gaskets, and bushings.
6. Inspect, test, adjust, repair, and/or replace electrical/electronic components and circuits.

AT-C. Off-Vehicle Transmission and Transaxle Repair

1. Describe the operational characteristics of a continuously variable transmission (CVT).
2. Describe the operational characteristics of a hybrid vehicle drive train.
3. Remove and reinstall transmission/transaxle and torque converter; inspect engine core plugs, rear crankshaft seal, dowel pins, dowel pin holes, and mounting surfaces.
4. Inspect, leak test, flush, and/or replace transmission/transaxle oil cooler, lines, and fittings.
5. Inspect converter flex (drive) plate, converter attaching bolts, converter pilot, converter pump drive surfaces, converter end play, and crankshaft pilot bore.
6. Disassemble, clean, and inspect transmission/transaxle.
7. Inspect, measure, clean, and replace valve body (includes surfaces, bores, springs, valves, switches, solenoids, sleeves, retainers, brackets, check valves/balls, screens, spacers, and gaskets).
8. Inspect servo and accumulator bores, pistons, seals, pins, springs, and retainers; determine needed action.
9. Assemble transmission/transaxle.
10. Inspect, measure, and reseal oil pump assembly and components.
11. Measure transmission/transaxle end play and/or preload; determine needed action.
12. Inspect, measure, and/or replace thrust washers and bearings.
13. Inspect oil delivery circuits, including seal rings, ring grooves, and sealing surface areas, feed pipes, orifices, and check valves/balls.
14. Inspect bushings; determine needed action.
15. Inspect and measure planetary gear assembly components; determine needed action.
16. Inspect case bores, passages, bushings, vents, and mating surfaces; determine needed action.
17. Diagnose and inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; determine needed action.
18. Inspect measure, repair, adjust or replace transaxle final drive components.
19. Inspect clutch drum, piston, check-balls, springs, retainers, seals, friction plates, pressure plates, and bands; determine needed action.
20. Measure clutch pack clearance; determine needed action.

21. Air test operation of clutch and servo assemblies.
22. Inspect one-way clutches, races, rollers, sprags, springs, cages, retainers; determine needed action.

III. MANUAL DRIVE TRAIN AND AXLES (MD)

Test Specification

Content Area	Questions In Test
A. General: Drive Train Diagnosis	5
B. Clutch Diagnosis and Repair	7
C. Transmission/Transaxle Diagnosis and Repair	8
D. Drive Shaft and Half Shaft, Universal and CV Joints	6
E. Differential and Drive Axles: Diagnosis and Repair	9
F. Four-wheel Drive/All-wheel Drive Component D&R	5
Required To Pass: 21 of 40	TOTAL 40

Task List

MD-A. General: Drive Train Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify manual drive train and axles components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Check fluid condition; check for leaks; determine needed action.
5. Drain and refill manual transmission/transaxle; use proper fluid type per manufacturer specification.
6. Diagnose drive train concerns; determine needed action.

MD-B. Clutch Diagnosis and Repair

1. Check and adjust clutch master cylinder fluid level; check for leaks; use proper fluid type per manufacturer specification.
2. Diagnose clutch noise, binding, slippage, pulsation, and chatter; determine needed action.
3. Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; determine needed action.
4. Inspect and/or replace clutch pressure plate assembly, clutch disc, release (throw-out) bearing, linkage, and pilot bearing/bushing (as applicable).
5. Bleed clutch hydraulic system.
6. Inspect flywheel and ring gear for wear, cracks, and discoloration; determine needed action.
7. Measure flywheel runout and crankshaft end play; determine needed action.
8. Describe the operation and service of a system that uses a dual mass flywheel.

MD-C. Transmission/Transaxle Diagnosis and Repair

1. Describe the operational characteristics of an electronically controlled manual transmission/transaxle.
2. Inspect, adjust, lubricate, and/or replace shift linkages, brackets, bushings, cables, pivots, and levers.
3. Diagnose noise concerns through the application of transmission/transaxle power flow principles; determine needed action.
4. Diagnose hard shifting and jumping out of gear concerns; determine needed action.
5. Diagnose transaxle final drive assembly noise and vibration concerns; determine needed action.
6. Disassemble, inspect clean, and reassemble internal transmission/transaxle components.

MD-D. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair

(Front, Rear, All-wheel, and Four-wheel Drive)

1. Inspect and/or remove/replace bearings, hubs, and seals.
2. Inspect and/or service/replace shafts, yokes, boots, and universal/CV joints.
3. Check for leaks at drive assembly and transfer case seals; check vents; check fluid level; use proper fluid type per manufacturer specification.
4. Diagnose constant-velocity (CV) joint noise and vibration concerns; determine needed action.
5. Diagnose universal joint noise and vibration concerns; determine needed action.
6. Check shaft balance and phasing; measure shaft runout; measure and adjust driveline angles; determine needed action.

MD-E. Differential and Drive Axles: Diagnosis and Repair

E.1 Ring and Pinion Gears and Differential Case Assembly

1. Inspect differential housing; check for leaks; inspect housing vent.
2. Check and adjust differential housing fluid level; use proper fluid type per manufacturer specification.
3. Drain and refill differential housing; use proper fluid type per manufacturer specification.
4. Inspect and replace companion flange and/or pinion seal; measure companion flange runout.
5. Inspect ring gear and measure runout; determine needed action.
6. Diagnose noise and vibration concerns; determine needed action.
7. Remove, inspect, reinstall, or replace drive pinion and ring gear, spacers, sleeves, and bearings.
8. Measure and adjust drive pinion depth.
9. Measure and adjust drive pinion bearing preload.
10. Measure and adjust side bearing preload and ring and pinion gear total backlash and backlash variation on a differential carrier assembly (threaded cup or shim types).
11. Check ring and pinion tooth contact patterns; determine needed action.
12. Disassemble, inspect, measure, adjust, and/or replace differential pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case.
13. Reassemble and reinstall differential case assembly; measure runout; determine needed action.

E.2 Drive Axles

1. Inspect and replace drive axle wheel studs.
2. Remove and replace drive axle shafts.
3. Inspect and replace drive axle shaft seals, bearings, and retainers.
4. Measure drive axle flange runout and shaft end play; determine needed action.
5. Diagnose drive axle shafts, bearings, and seals for noise, vibration, and fluid leakage concerns; determine needed action.

E.3 Limited Slip Differential

1. Diagnose noise, slippage, and chatter concerns including electronically controlled systems; determine needed action.
2. Measure rotating torque; determine needed action.

MD-F. Four-wheel Drive/All-wheel Drive Component Diagnosis and Repair

1. Identify concerns related to variations in tire circumference and/or final drive ratios.
2. Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets.
3. Inspect axle locking mechanisms; determine needed action(s).
4. Check for leaks at drive assembly and transfer case seals; check vents; check fluid level; use proper fluid type per manufacturer specification.
5. Diagnose noise, vibration, and unusual steering concerns; determine needed action.
6. Diagnose, test, adjust, and/or replace electrical/electronic components of four-wheel drive/all-wheel drive systems.
7. Disassemble, service, and reassemble transfer case and components.

IV. SUSPENSION AND STEERING (SS)

Test Specification

Content Area	Questions In Test
A. General: Suspension and Steering Systems	3
B. Steering Systems Diagnosis and Repair	8
C. Suspension Systems Diagnosis and Repair	8
D. Related Suspension and Steering Service	4
E. Wheel Alignment Diagnosis, Adjustment, and Repair	10
F. Wheels and Tires Diagnosis and Repair	7
Required To Pass: 20 of 40	TOTAL 40

Task List

SS-A. General Suspension and Steering Systems

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify suspension and steering system components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Disable and enable supplemental restraint system (SRS); verify indicator lamp operation.
5. Identify and interpret suspension and steering system concerns; determine needed action.

SS-B. Steering Systems Diagnosis and Repair

1. Inspect rack and pinion steering gear tie rod ends (sockets) and bellows boots; repair or replace as needed.
2. Inspect power steering fluid level and condition.
3. Drain and replace power steering system fluid; use proper fluid type per manufacturer specification.
4. Inspect for power steering fluid leakage; determine needed action.
5. Remove, inspect, replace, and/or adjust power steering pump drive belt.
6. Inspect, remove, and/or replace power steering hoses and fittings.
7. Inspect, remove, and/or replace pitman arm, relay (centerlink/intermediate) rod, idler arm, mountings, and steering linkage damper.
8. Inspect, replace, and/or adjust tie rod ends (sockets), tie rod sleeves, and clamps (non-rack and pinion).
9. Inspect and test electric power steering system; determine needed action.
10. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil (clock spring).
11. Diagnose steering column noises, looseness, and binding concerns (including tilt/telescoping mechanisms); determine needed action.
12. Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine needed action.
13. Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine needed action.
14. Inspect steering shaft universal joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; determine needed action.
15. Remove and replace rack and pinion steering gear; inspect mounting bushings and brackets.
16. Remove and reinstall power steering pump.
17. Remove and reinstall press fit power steering pump pulley; check pulley and belt alignment.
18. Test power steering system pressure; determine needed action.

SS-C. Suspension Systems Diagnosis and Repair

1. Inspect, remove, and/or replace upper and/or lower control arms, bushings, and shafts.
2. Inspect and replace rebound/jounce bumpers.

3. Inspect, remove, and/or replace track bar, strut rods/radius arms, and related mounts and bushings.
4. Inspect, remove, and/or replace upper and/or lower ball joints (with or without wear indicators).
5. Inspect, remove, and/or replace suspension system coil springs and spring insulators.
6. Inspect, remove, and/or replace torsion bars and mounts.
7. Inspect, remove, and/or replace front/rear stabilizer bar (sway bar) bushings, brackets, and links.
8. Inspect, remove, and/or replace strut assembly, strut coil spring, insulators, and upper strut bearing mount.
9. Inspect, remove, and/or replace components of suspension systems (Coil, Leaf, and Torsion).
10. Inspect, remove, and/or replace components of electronically controlled suspension systems.
11. Inspect, remove, and/or replace steering knuckle assemblies.
12. Diagnose suspension system noises, body sway, and uneven ride height concerns; determine needed action.

SS-D. Related Suspension and Steering Service

1. Inspect, remove, and/or replace shock absorbers; inspect mounts and bushings.
2. Inspect, service, and/or replace front and rear wheel bearings.
3. Describe the function of electronically controlled suspension and steering systems and components, (i.e., active suspension and stability control).

SS-E. Wheel Alignment Diagnosis, Adjustment, and Repair

1. Perform pre-alignment inspection; measure vehicle ride height; determine needed action.
2. Describe four-wheel alignment angles (camber, caster, and toe) and effects on vehicle handling\tire wear.
3. Prepare vehicle for wheel alignment on alignment machine; perform four-wheel alignment by checking and adjusting front caster, front and rear camber, and toe as required; center steering wheel.
4. Check toe-out-on-turns (turning radius); determine needed action.
5. Check steering axis inclination (SAI) and included angle; determine needed action.
6. Check rear wheel thrust angle; determine needed action.
7. Check for front wheel setback; determine needed action.
8. Identify front and/or rear cradle (subframe) misalignment; determine needed action.
9. Reset steering angle sensor.
10. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine needed action.

SS-F. Wheels and Tires Diagnosis and Repair

1. Inspect tire condition/age; identify tire wear patterns; check for correct tire size, application (service-class, load, and speed ratings), and air pressure as listed on the tire information placard/label.
2. Rotate tires according to manufacturer’s recommendation including vehicles equipped with tire pressure monitoring systems (TPMS)
3. Dismount, inspect, and remount tire on wheel (with/without TPMS); balance wheel and tire assembly.

4. Inspect tire and wheel assembly for air loss; determine needed action.
5. Repair tire following tire manufacturer approved procedure.
6. Identify indirect and direct tire pressure monitoring system (TPMS); calibrate/relearn system; verify operation of instrument panel lamps.
7. Demonstrate knowledge of steps required to remove and replace sensors (per OEM/sensor manufacturer) in a tire pressure monitoring system (TPMS).
8. Perform Road Force balance/match mounting.
9. Diagnose wheel/tire vibration, shimmy, and noise; determine needed action.
10. Measure wheel, tire, axle flange, and hub runout; determine needed action.
11. Diagnose tire pull problems; determine needed action.

V. BRAKES (BR)

Test Specification

Content Area	Questions In Test
A. General: Brake Systems Diagnosis	4
B. Hydraulic System Diagnosis and Repair	8
C. Drum Brake Diagnosis and Repair	5
D. Disc Brakes Diagnosis and Repair	8
E. Power-Assist Units Diagnosis and Repair	3
F. Related Systems (Wheel Bearings, Parking Brakes, Electrical) D&R	5
G. Electronic Brake Control Systems: ABS, TCS, and ESC D&R	7
Required To Pass: 21 of 40	TOTAL 40

Task List

BR-A. General: Brake Systems Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify brake system components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Describe procedure for performing a road test to check brake system operation, including an anti-lock brake system (ABS).
5. Install wheel and torque lug nuts.
6. Identify and interpret brake system concerns; determine needed action.

BR-B. Hydraulic System Diagnosis and Repair

1. Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's Law).
2. Measure brake pedal height, travel, and free play (as applicable); determine needed action.
3. Check master cylinder for internal/external leaks and proper operation; determine needed action.

4. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, wear, and loose fittings/supports; determine needed action.
5. Select, handle, store, and fill brake fluids to proper level; use proper fluid type per manufacturer specification.
6. Identify components of hydraulic brake warning light system.
7. Bleed and/or replace fluid in the brake system.
8. Test brake fluid for contamination.
9. Remove, bench bleed, and reinstall master cylinder.
10. Diagnose poor stopping, pulling, or dragging concerns caused by malfunctions in the hydraulic system; determine needed action.
11. Replace brake lines, hoses, fittings, and supports.
12. Fabricate brake lines using proper material and flaring procedures.
13. Inspect, test, and/or replace components of brake warning light system.

BR-C. Drum Brakes Diagnosis and Repair

1. Remove, clean, and inspect brake drum; measure brake drum diameter; determine serviceability.
2. Refinish brake drum and measure final drum diameter; compare with specification.
3. Remove, clean, inspect, and/or replace brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.
4. Inspect wheel cylinders for leaks and proper operation; remove and replace as needed.
5. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments.
6. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pedal pulsation concerns; determine needed action.

BR-D. Disc Brakes Diagnosis and Repair

1. Remove and clean caliper assembly; inspect for leaks, damage, and wear; determine needed action.
2. Inspect caliper mounting and slides/pins for proper operation, wear, and damage; determine needed action.
3. Remove, inspect, and/or replace brake pads and retaining hardware; determine needed action.
4. Lubricate and reinstall caliper, brake pads, and related hardware; seat brake pads against rotor; inspect for leaks.
5. Clean and inspect rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine needed action.
6. Remove and reinstall/replace rotor.
7. Refinish rotor on vehicle; measure final rotor thickness and compare with specification.
8. Refinish rotor off vehicle; measure final rotor thickness and compare with specification.
9. Retract and re-adjust caliper piston on an integrated parking brake system.
10. Describe importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendation.
11. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pulsation concerns; determine needed action.

BR-E. Power-Assist Units Diagnosis and Repair

1. Check brake pedal travel with and without engine running to verify proper power booster operation.
2. Identify components of the brake power assist system (vacuum/ hydraulic/electric).
3. Inspect vacuum-type power booster unit for leaks; inspect the check-valve for proper operation; check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster determine needed action.
4. Inspect and test hydraulically assisted power brake system for leaks and proper operation; determine needed action.
5. Inspect electric power booster unit; determine needed action.

BR-F. Related Systems (i.e., Wheel Bearings, Parking Brakes, Electrical) Diagnosis and Repair

1. Remove, clean, inspect, repack/replace, and install wheel bearings; remove and install bearing races; replace seals; install hub and adjust bearings.
2. Check parking brake system components for wear, binding, and corrosion; clean, lubricate, adjust and/or replace as needed.
3. Check parking brake operation (including electric parking brakes); check parking brake indicator light system operation; determine needed action.
4. Check operation of brake stop light system.
5. Inspect and replace wheel studs.
6. Remove, reinstall, and/or replace sealed wheel bearing assembly.
7. Diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine needed action.

BR-G. Electronic Brake Control Systems: Antilock Brake (ABS), Traction Control (TCS), and Electronic Stability Control (ESC) Systems Diagnosis and Repair

1. Identify and inspect electronic brake control system components and describe function (ABS, TCS, ESC); determine needed action.
2. Describe the operation of a regenerative braking system.
3. Bleed the electronic brake control system hydraulic circuits.
4. Diagnose poor stopping, wheel lock-up, abnormal pedal feel, unwanted application, and noise concerns associated with the electronic brake control system; determine needed action.
5. Diagnose electronic brake control system electronic control(s) and components by retrieving diagnostic trouble codes, and/or using recommended test equipment; determine needed action.
6. Depressurize high-pressure components of an electronic brake control system.
7. Test, diagnose, and service electronic brake control system speed sensors (digital and analog), toothed ring (tone wheel), and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO) (includes output signal, resistance, shorts to voltage/ground, and frequency data).
8. Diagnose electronic brake control system braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).

VI. ELECTRICAL/ELECTRONIC SYSTEMS (EE)

Test Specification

Content Areas	Questions In Test
A. General: Electrical System Diagnosis	11
B. Battery Diagnosis and Service	5
C. Starting System Diagnosis and Service	5
D. Charging System Diagnosis and Service	5
E. Lighting Systems Diagnosis and Service	4
F. Instrument Cluster and Driver Information Systems D&R	3
G. Body Electrical Systems Diagnosis and Service	7
Required To Pass: 20 of 40	TOTAL 40

Task List

EE-A. General: Electrical System Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify electrical/electronic system components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law).
5. Demonstrate proper use of a digital multimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow and resistance.
6. Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits.
7. Describe types of test lights; use appropriate test light to check operation of electrical circuits per service information.
8. Use fused jumper wires to check operation of electrical circuits per service information.
9. Use wiring diagrams during the diagnosis of electrical/electronic circuit problems.
10. Diagnose the cause(s) of excessive key-off battery drain (parasitic draw); determine needed action.
11. Inspect and test fusible links, circuit breakers, and fuses; determine needed action.
12. Inspect, test, repair, and/or replace components, connectors, terminals, harnesses, and wiring in electrical/electronic systems (including solder repairs); determine needed action.
13. Test and measure circuit using an oscilloscope and/or graphing multimeter (GMM); interpret results; determine needed action.

EE-B. Battery Diagnosis and Service (Conventional 12-volt)

1. Perform battery state-of-charge test; determine needed action.
2. Confirm proper battery capacity, size, type, and application for vehicle; perform battery capacity and load test; determine needed action.

3. Maintain or restore electronic memory functions as recommended by manufacturer.
4. Inspect and clean battery; fill battery cells (if applicable); check battery cables, connectors, clamps, and hold-downs.
5. Perform battery charging according to manufacturer's recommendations.
6. Jump-start vehicle using jumper cables and a booster battery or an auxiliary power supply.
7. Identify electrical/electronic modules, security systems, radios, and other accessories that require reinitialization or code entry after reconnecting vehicle battery.

EE-C. Starting System Diagnosis and Repair

1. Perform starter current draw test; determine needed action.
2. Perform starter circuit voltage drop tests; determine needed action.
3. Inspect and test starter relays and solenoids; determine needed action.
4. Remove and install starter in a vehicle.
5. Inspect and test switches, connectors, and wires of starter control circuits; determine needed action.
6. Demonstrate knowledge of an automatic idle-stop/start-stop system.
7. Differentiate between electrical and engine mechanical problems that cause a slow-crank or a no-crank condition.

EE-D. Charging System Diagnosis and Repair

1. Perform charging system output test; determine needed action.
2. Inspect, adjust, and/or replace generator (alternator) drive belts; check pulleys and tensioners for wear; check pulley and belt alignment; determine needed action.
3. Remove, inspect, and/or replace generator (alternator); determine needed action.
4. Perform charging circuit voltage drop tests; determine needed action.
5. Diagnose charging system for causes of undercharge, no-charge, or overcharge conditions; determine needed action.

EE-E. Lighting Systems Diagnosis and Repair

1. Inspect interior and exterior lamps and sockets including headlights and auxiliary lights (fog lights/driving lights); determine needed action.
2. Aim headlights.
3. Diagnose the causes of brighter-than-normal, intermittent, dim, or no light operation; determine needed action.

EE-F. Instrument Cluster and Driver Information Systems Diagnosis and Repair

1. Verify operation of instrument panel gauges and warning/indicator lights; reset maintenance indicators as required.
2. Inspect and test gauges and gauge sending units for causes of abnormal readings; determine needed action.
3. Diagnose the causes of incorrect operation of warning devices and other driver information systems; determine needed action.

EE-G. Body Electrical Systems Diagnosis and Repair

1. Diagnose vehicle comfort, convenience, access, safety, and related systems operation; determine needed action.
2. Remove and reinstall door panel.
3. Diagnose operation of security/anti-theft systems and related circuits (such as: theft deterrent, door locks, remote keyless entry, remote start, and starter/fuel disable); determine needed action.
4. Describe disabling and enabling procedures for supplemental restraint system (SRS); verify indicator lamp operation.
5. Verify windshield wiper and washer operation; replace wiper blades.
6. Diagnose operation of entertainment and related circuits (such as: radio, DVD, remote CD changer, navigation, amplifiers, speakers, antennas, and voice-activated accessories); determine needed action.
7. Diagnose operation of safety systems and related circuits (such as: horn, airbags, seat belt pretensioners, occupancy classification, wipers, washers, speed control/collision avoidance, heads-up display, parking assist, and back-up camera); determine needed action.
8. Diagnose body electronic systems circuits using a scan tool; check for module communication errors (data communication bus systems); determine needed action.
9. Describe the process for software transfer, software updates, or reprogramming of electronic modules.

VII. HEATING, VENTILATION, AND AIR CONDITIONING (AC)

Test Specification

Content Areas	Questions In Test
A. General: A/C System Diagnosis and Repair	11
B. Refrigeration System Component Diagnosis and Repair	9
C. Heating, Ventilation, and Engine Cooling Systems D&R	4
D. Operating Systems and Related Controls Diagnosis and Repair	11
E. Refrigerant Recovery, Recycling, and Handling	5
Required To Pass: 20 of 40	TOTAL 40

Task List

AC-A. General: A/C System Diagnosis and Repair

1. Research vehicle service information, including refrigerant/oil/fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify heating, ventilation, and air conditioning (HVAC) components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Perform A/C system performance test; interpret results; determine needed action.

5. Identify abnormal operating noises in the A/C system; determine needed action.
6. Leak test A/C system; determine needed action.
7. Identify and interpret heating and air conditioning problems; determine needed action.
8. Identify refrigerant type; test for sealant; select and connect proper gauge set/test equipment; record temperature and pressure readings.
9. Inspect condition/quantity of refrigerant oil removed from A/C system; determine needed action.
10. Determine recommended oil and oil capacity for system application and component(s) replacement**.**

AC-B. Refrigeration System Component Diagnosis and Repair

1. Inspect, remove, and/or replace A/C compressor drive belts, pulleys, tensioners; determine needed action.
2. Inspect for proper A/C condenser airflow; determine needed action.
3. Inspect evaporator housing condensation drain; determine needed action.
4. Inspect, test, and/or service A/C compressor clutch components and/or assembly; determine needed action.
5. Remove, inspect, reinstall, and/or replace A/C compressor and mountings; determine recommended oil type and quantity.
6. Remove and inspect A/C system mufflers, hoses, lines, fittings, O-rings, seals, and service valves; determine needed action.
7. Remove, inspect, and replace receiver/drier or accumulator/drier; determine recommended oil type and quantity.
8. Remove, inspect, and install expansion valve or orifice (expansion) tube.
9. Diagnose A/C system conditions that cause the protection devices (pressure, thermal, and/or control module) to interrupt system operation; determine needed action.
10. Determine procedure to remove and reinstall evaporator; determine required oil type and quantity.
11. Remove, inspect, reinstall, and/or replace condenser; determine required oil type and quantity.

AC-C. Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair

1. Inspect engine cooling and heater systems hoses and pipes; determine needed action.
2. Inspect and test heater control valve(s); determine needed action.
3. Diagnose temperature control problems in the HVAC system related to the engine cooling system, including electric heating; determine needed action.
4. Determine procedure to remove, inspect, reinstall, and/or replace heater core; properly refill system.

AC-D. Operating Systems and Related Controls Diagnosis and Repair

1. Inspect HVAC system ducts, doors, hoses, cabin filters, and outlets; determine needed action.
2. Identify the source of HVAC system odors.
3. Inspect and test HVAC system blower motors, resistors, switches, relays, wiring, and protection devices; determine needed action.
4. Diagnose A/C compressor control systems; determine needed action.

5. Diagnose malfunctions in the vacuum, mechanical, and/or electrical components and controls of the HVAC system; determine needed action.
6. Inspect, test, remove and/or replace HVAC system control panel; determine needed action.
7. Check operation of automatic HVAC control systems; determine needed action.

AC-E. Refrigerant Recovery, Recycling, and Handling

1. Demonstrate awareness of the need to recover, recycle, and handle refrigerants using proper equipment and procedures.
2. Use and maintain refrigerant handling equipment according to equipment manufacturer's standards.
3. Identify A/C system refrigerant; test for sealants; recover, evacuate, and charge A/C system; add refrigerant oil as required.
4. Recycle, label, and store refrigerant.

VIII. ENGINE PERFORMANCE (EP)

Test Specification

Content Areas	Questions In Test
A. General: Engine Diagnosis	10
B. Computerized Controls Diagnosis and Repair	11
C. Ignition System Diagnosis and Repair	6
D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair	7
E. Emissions Control Systems Diagnosis and Repair	6
Required To Pass: 21 of 40	TOTAL 40

Task List

EP-A. General: Engine Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
3. Verify proper engine cooling system operation; determine needed action.
4. Verify correct camshaft timing including engines equipped with variable valve timing (VVT) systems; determine needed action.
5. Identify and interpret engine performance concerns; determine needed action.
6. Diagnose abnormal engine noises or vibration concerns; determine needed action.
7. Diagnose the cause of excessive oil consumption, coolant consumption, unusual exhaust color, odor, and sound; determine needed action.
8. Perform engine manifold pressure tests (vacuum/boost); determine needed action.
9. Perform cylinder power balance test; determine needed action.
10. Perform cylinder cranking and running compression tests; determine needed action.

11. Perform cylinder leakage test; determine needed action.
12. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns; determine needed action.

EP-B. Computerized Controls Diagnosis and Repair

1. Identify computerized control system components and configurations.
2. Access and use service information to perform step-by-step (troubleshooting) diagnosis.
3. Perform active tests of actuators using a scan tool; determine needed action.
4. Describe the use of OBD monitors for repair verification.
5. Inspect and test computerized engine control system sensors, powertrain/engine control module (PCM/ECM), actuators, and circuits using a graphing multimeter (GMM), digital storage oscilloscope (DSO), and/or scan tool; determine needed action.
6. Describe the process for reprogramming or recalibrating the powertrain/engine control module (PCM/ECM).
7. Diagnose the causes of emissions or driveability concerns with stored or active diagnostic trouble codes (DTC); obtain, graph, and interpret scan tool data.
8. Diagnose emissions or driveability concerns without stored or active diagnostic trouble codes; determine needed action.
9. Diagnose driveability and emissions problems resulting from malfunctions of interrelated systems (cruise control, security alarms, suspension controls, traction controls, HVAC, automatic transmissions, non-OEM installed accessories, or similar systems); determine needed action.

EP-C. Ignition System Diagnosis and Repair

1. Identify ignition system components and configurations.
2. Remove and replace spark plugs; inspect secondary ignition components for wear and damage; determine needed action.
3. Diagnose ignition system related problems such as no-starting, hard starting, engine misfire, poor driveability, spark knock, power loss, poor mileage, and emissions concerns; determine needed action.
4. Inspect and test crankshaft and camshaft position sensor(s); determine needed action.
5. Inspect, test, and/or replace ignition control module and/or powertrain/engine control module; reprogram/initialize as needed.

EP-D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair

1. Identify fuel, air induction, and exhaust system components and configurations.
2. Replace fuel filter(s) where applicable.
3. Inspect, service, or replace air filters, filter housings, and intake duct work.
4. Inspect integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shields; determine needed action.
5. Inspect condition of exhaust system hangers, brackets, clamps, and heat shields; determine needed action.
6. Check and refill diesel exhaust fluid (DEF).
7. Check fuel for quality, composition, and contamination; determine needed action.

8. Inspect and test fuel pump(s) and pump control system for pressure, regulation, and volume; determine needed action.
9. Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air.
10. Inspect, test, and/or replace fuel injectors on low- and high-pressure systems.
11. Verify proper idle speed; determine needed action.
12. Perform exhaust system back-pressure test; determine needed action.
13. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems; determine needed action.
14. Test the operation of turbocharger/supercharger systems; determine needed action.

EP-E. Emissions Control Systems Diagnosis and Repair

1. Identify emission control system components and configurations.
2. Inspect, test, service, and/or replace positive crankcase ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses; determine needed action.
3. Diagnose oil leaks, emissions, and driveability concerns caused by the positive crankcase ventilation (PCV) system; determine needed action.
4. Diagnose emissions and driveability concerns caused by the exhaust gas recirculation (EGR) system; inspect, test, service and/or replace electrical/electronic sensors, controls, wiring, tubing, exhaust passages, vacuum/pressure controls, filters, and hoses of exhaust gas recirculation (EGR) systems; determine needed action.
5. Inspect and test electrical/electronically operated components and circuits of secondary air injection systems; determine needed action.
6. Diagnose emission and driveability concerns caused by catalytic converter system; determine needed action.
7. Diagnose emissions and driveability concerns caused by the evaporative emissions control (EVAP) system; determine needed action.
8. Interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems; determine needed action.

MAINTENANCE AND LIGHT REPAIR (MR)

Test Specification

Content Area	Questions In Test
A. Engine Repair (ER)	6
B. Automatic Transmission and Transaxle (AT)	3
C. Manual Drive Train and Axles (MD)	3
D. Suspension and Steering (SS)	10
E. Brakes (BR)	11
F. Electrical/Electronic Systems (EE)	11
G. Heating, Ventilation, and Air Conditioning (AC)	3
H. Engine Performance (EP)	6
I. Foundational Tasks (GT)	7
Required To Pass: 31 of 60	TOTAL 60

Task List

I. ENGINE REPAIR

ER-A. General: Engine Diagnosis

1. Research vehicle service information such as fluid type, internal combustion engine operation, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
3. Verify operation of the instrument panel engine warning indicators.
4. Inspect engine assembly for fuel, oil, coolant, and other leaks.
5. Install engine covers using gaskets, seals, and sealers as required.
6. Demonstrate understanding of the procedure for verifying engine mechanical timing.
7. Inspect engine mounts.
8. Identify service precautions related to service of the internal combustion engine of a hybrid electric vehicle.

ER-B. Cylinder Head and Valve Train

1. Identify cylinder head and valve train components and configurations.

ER-C. Engine Block Assembly

1. Identify engine block assembly components and configurations.

ER-D. Lubrication and Cooling Systems

1. Identify lubrication and cooling system components and configurations.
2. Perform engine oil and filter change; use proper fluid type per manufacturer specification; reset maintenance reminder as required.

3. Perform cooling system pressure and dye tests to identify leaks; check coolant condition and level; inspect and test radiator, pressure cap, coolant recovery tank, heater core, and galley plugs.
4. Identify causes of engine overheating
5. Inspect, replace, and/or adjust drive belts, tensioners, and pulleys; check pulley and belt alignment.
6. Inspect and test coolant; drain and recover coolant; flush and/or refill cooling system; use proper fluid type per manufacturer specification; bleed air as required.
7. Identify type of water pumps (belt driven, chain driven, and electric).
8. Remove, inspect, and replace thermostat and gasket/seal.

II. AUTOMATIC TRANSMISSION AND TRANSAXLE

AT-A. General: Transmission and Transaxle Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify automatic transmission and transaxle components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle equipped with a dipstick.
5. Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle not equipped with a dipstick.
6. Demonstrate knowledge of transmission/transaxle gear reduction/multiplication operation using driving, driven, and held member (power flow) principles.
7. Demonstrate knowledge of hydraulic principles (Pascal's Law) in a transmission/transaxle.

AT-B. In-Vehicle Transmission/Transaxle

1. Inspect external manual valve shift linkage, transmission range sensor/switch, and/or park/neutral position switch.
2. Drain and replace fluid and filter(s); use proper fluid type per manufacturer specification.
3. Demonstrate understanding of relearn procedures.
4. Inspect, replace and/or align power train mounts.

AT-C. Off-Vehicle Transmission and Transaxle

1. Describe the operational characteristics of a continuously variable transmission (CVT).
2. Describe the operational characteristics of a hybrid vehicle drive train.

III. MANUAL DRIVE TRAIN AND AXLES

MD-A. General: Drive Train Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).

2. Identify manual drive train and axle components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Check fluid condition; check for leaks.
5. Drain and refill manual transmission/transaxle; use proper fluid type per manufacturer specification.

MD-B. Clutch

1. Check and adjust clutch master cylinder fluid level; check for leaks; use proper fluid type per manufacturer specification.

MD-C. Transmission/Transaxle

1. Describe the operational characteristics of an electronically controlled manual transmission/transaxle.

MD-D. Drive Shaft, Half Shafts, Universal Joints, and Constant-Velocity (CV) Joints (Front, Rear, All, and Four- wheel drive)

1. Inspect, remove, and/or replace bearings, hubs, and seals.
2. Inspect, service, and/or replace shafts, yokes, boots, and universal/CV joints.
3. Check for leaks at drive assembly and transfer case seals; check vents; check fluid level; use proper fluid type per manufacturer specification.

MD-E. Differential and Drive Axles

E.1 Ring and Pinion Gears and Differential Housing Assembly

1. Inspect differential housing; check for leaks; inspect housing vent.
2. Check and adjust differential housing fluid level; use proper fluid type per manufacturer specification.
3. Drain and refill differential housing; using proper fluid type per manufacturer specification.

E.2 Drive Axles

1. Inspect and replace drive axle wheel studs.

MD-F. Four-wheel Drive/All-wheel Drive

1. Identify concerns related to variations in tire circumference and/or final drive ratios.

IV. SUSPENSION AND STEERING SYSTEMS

SS-A. General: Suspension and Steering Systems

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify suspension and steering system components and configurations.

3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Disable and enable supplemental restraint system (SRS); verify indicator lamp operation.

SS-B. Related Suspension and Steering Service

1. Inspect rack and pinion steering gear tie rod ends (sockets) and bellows boots.
2. Inspect power steering fluid level and condition.
3. Drain and replace power steering system fluid; use proper fluid type per manufacturer specification.
4. Inspect for power steering fluid leakage.
5. Remove, inspect, replace, and/or adjust power steering pump drive belt.
6. Inspect, remove, and/or replace power steering hoses and fittings.
7. Inspect pitman arm, relay (centerlink/intermediate) rod, idler arm, mountings, and steering linkage damper.
8. Inspect tie rod ends (sockets), tie rod sleeves, and clamps (non-rack and pinion).
9. Inspect electric power steering system.

SS-C. Suspension Systems

1. Inspect upper and/or lower control arms, bushings, and shafts.
2. Inspect and replace rebound/jounce bumpers.
3. Inspect track bar, strut rods/radius arms, and related mounts and bushings.
4. Inspect upper and/or lower ball joints (with or without wear indicators).
5. Inspect suspension system coil springs and spring insulators.
6. Inspect torsion bars and mounts.
7. Inspect and/or replace front/rear stabilizer bar (sway bar) bushings, brackets, and links.
8. Inspect, remove, and/or replace strut assembly, strut coil spring, insulators, and upper strut bearing mount.
9. Inspect components of suspension systems (Coil, Leaf, and Torsion).
10. Inspect components of electronically controlled suspension systems.

SS-D. Related Suspension and Steering Service

1. Inspect, remove, and/or replace shock absorbers; inspect mounts and bushings.
2. Inspect front and rear wheel bearings.
3. Describe the function of electronically controlled suspension and steering systems and components, (i.e., active suspension and stability control).

SS-E. Wheel Alignment

1. Perform pre-alignment inspection; measure vehicle ride height.
2. Describe four-wheel alignment angles (camber, caster, and toe) and effects on vehicle handling\tire wear.

SS-F. Wheels and Tires

1. Inspect tire condition/age; identify tire wear patterns; check for correct tire size, application (service-class, load, and speed ratings), and air pressure as listed on the tire information placard/label.
2. Rotate tires according to manufacturer's recommendations including vehicles equipped with tire pressure monitoring systems (TPMS).
3. Dismount, inspect, and remount tire on wheel (with/without TPMS); balance wheel and tire assembly.
4. Inspect tire and wheel assembly for air loss; determine needed action.
5. Repair tire following tire manufacturer approved procedure.
6. Identify indirect and direct tire pressure monitoring systems (TPMS); calibrate/relearn system; verify operation of instrument panel lamps.
7. Demonstrate knowledge of steps required to remove and replace sensors (per OEM/sensor manufacturer) in a tire pressure monitoring system (TPMS).
8. Perform Road Force balance/match mounting.

V. BRAKES

BR-A. General: Brake Systems Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify brake system components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Describe procedure for performing a road test to check brake system operation, including an anti-lock brake system (ABS).
5. Install wheel and torque lug nuts.

BR-B. Hydraulic System

1. Demonstrate understanding of hydraulic principles (Pascal's law).
2. Describe proper brake pedal height, travel, and feel.
3. Check master cylinder for proper operation.
4. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, wear, and loose fittings/supports.
5. Select, handle, store, and fill brake fluids to proper level; use proper fluid type per manufacturer specification.
6. Identify components of hydraulic brake warning light system.
7. Bleed and/or replace fluid in the brake system.
8. Test brake fluid for contamination.

BR-C. Drum Brakes

1. Remove, clean, and inspect brake drum; measure brake drum diameter; determine serviceability.

2. Refinish brake drum and measure final drum diameter; compare with specification.
3. Remove, clean, inspect, and/or replace brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.
4. Inspect wheel cylinders for leaks and proper operation; remove and replace as needed.
5. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; make final checks and adjustments.

BR-D. Disc Brakes

1. Remove and clean caliper assembly; inspect for leaks and damage, and wear.
2. Inspect caliper mounting and slides/pins for proper operation, wear, and damage.
3. Remove, inspect, and/or replace brake pads and retaining hardware.
4. Lubricate and reinstall caliper, brake pads, and related hardware; seat brake pads against rotor; inspect for leaks.
5. Clean and inspect rotor and mounting surface, measure rotor thickness, thickness variation, and lateral runout.
6. Remove and reinstall/replace rotor.
7. Refinish rotor on vehicle; measure final rotor thickness and compare with specification.
8. Refinish rotor off vehicle; measure final rotor thickness and compare with specification.
9. Retract and re-adjust caliper piston on an integrated parking brake system.
10. Describe importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendation.

BR-E. Power-Assist Units

1. Check brake pedal travel with, and without, engine running to verify proper power booster operation.
2. Identify components of the brake power assist system (vacuum/ hydraulic/electric).

BR-F. Related Systems (i.e., Wheel Bearings, Parking Brakes, Electrical)

1. Remove, clean, inspect, repack, and install wheel bearings; replace seals; install hub and adjust bearings.
2. Check parking brake system components for wear, binding, and corrosion; clean, lubricate, adjust and/or replace as needed.
3. Check parking brake operation (including electric parking brakes); check parking brake indicator light system operation.
4. Check operation of brake stop light system.
5. Inspect and replace wheel studs.

BR-G. Electronic Brake Control Systems: Antilock Brake (ABS), Traction Control (TCS) and Electronic Stability Control (ESC) Systems

1. Identify electronic brake control system components and describe function (ABS, TCS, ESC).
2. Describe the operation of a regenerative braking system.

VI. ELECTRICAL/ELECTRONIC SYSTEMS

EE-A. General: Electrical System Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify electrical/electronic system components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law).
5. Demonstrate proper use of a digital multimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow, and resistance.
6. Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits.
7. Describe types of test lights; use appropriate test light to check operation of electrical circuits per service information.
8. Use fused jumper wires to check operation of electrical circuits per service information.
9. Use wiring diagrams to trace electrical/electronic circuits.
10. Measure key-off battery drain (parasitic draw).
11. Inspect and test fusible links, circuit breakers, and fuses.
12. Repair and/or replace connectors, terminal ends, and wiring of electrical/electronic systems (including solder repair).

EE-B. Batteries (Conventional 12-volt)

1. Perform battery state-of-charge test; determine needed action.
2. Confirm proper battery capacity, size, type, and application for vehicle; perform battery capacity and load test.
3. Maintain or restore electronic memory functions as recommended by manufacturer.
4. Inspect and clean battery; fill battery cells (if applicable); check battery cables, connectors, clamps, and hold-downs.
5. Perform battery charging according to manufacturer's recommendations.
6. Jump-start vehicle using jumper cables and a booster battery or an auxiliary power supply.
7. Identify electrical/electronic modules, security systems, radios, and other accessories that require reinitialization or code entry after reconnecting vehicle battery.

EE-C. Starting System

1. Perform starter current draw test.
2. Perform starter circuit voltage drop tests.
3. Inspect and test starter relays and solenoids.
4. Remove and install starter in a vehicle.
5. Inspect and test switches, connectors, and wires of starter control circuits.
6. Demonstrate knowledge of an automatic idle-stop/start-stop system.

EE-D. Charging System

1. Perform charging system output test.
2. Inspect, adjust, and/or replace generator (alternator) drive belts; check pulleys and tensioners for wear; check pulley and belt alignment.
3. Remove, inspect, and/or replace generator (alternator).
4. Perform charging circuit voltage drop tests.

EE-E. Lighting Systems

1. Inspect interior and exterior lamps and sockets including headlights and auxiliary lights (fog lights/driving lights); replace as needed.
2. Aim headlights.

EE-F. Instrument Cluster and Driver Information Systems

1. Verify operation of instrument panel gauges and warning/indicator lights; reset maintenance indicators as required.

EE-G. Body Electrical Systems

1. Demonstrate understanding of vehicle comfort, convenience, access, safety, and related systems operation.
2. Remove and reinstall door panel.
3. Describe the operation of keyless entry/remote-start systems.
4. Describe disabling and enabling procedures for supplemental restraint system (SRS); verify indicator lamp operation.
5. Verify windshield wiper and washer operation; replace wiper blades.

VII. HEATING, VENTILATION, AND AIR CONDITIONING

AC-A. General: A/C System Diagnosis and Repair

1. Research vehicle service information, including refrigerant/oil/fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify heating, ventilation, and air conditioning (HVAC) components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Identify steps of an A/C performance test.
5. Identify abnormal operating noises in the A/C system.
6. Visually inspect A/C system for signs of leaks.
7. Identify and interpret heating and air conditioning problems.

AC-B. Refrigeration System Components

1. Inspect and/or replace A/C compressor drive belts, pulleys, and tensioners.
2. Inspect for proper A/C condenser airflow.
3. Inspect evaporator housing condensation drain.

AC-C. Heating, Ventilation, and Engine Cooling Systems

1. Inspect engine cooling and heater systems hoses and pipes.

AC-D. Operating Systems and Related Controls

1. Inspect HVAC system ducts, doors, hoses, cabin filters, and outlets.
2. Identify the source of HVAC system odors.

AC-E. Refrigerant Recovery, Recycling, and Handling

1. Demonstrate awareness of the need to recover, recycle, and handle refrigerants using proper equipment and procedures.

VIII. ENGINE PERFORMANCE

EP-A. General: Engine Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
3. Demonstrate understanding of proper engine cooling system operation.
4. Demonstrate understanding of camshaft timing including engines equipped with variable valve timing (VVT) systems.

EP-B. Computerized Controls

1. Identify computerized control system components and configurations.

EP-C. Ignition System

1. Identify ignition system components and configurations.
2. Remove and replace spark plugs; inspect secondary ignition components for wear and damage.

EP-D. Fuel, Air Induction, and Exhaust Systems

1. Identify fuel, air induction, and exhaust system components and configurations.
2. Replace fuel filter(s) where applicable.
3. Inspect, service, or replace air filters, filter housings, and intake duct work.
4. Inspect integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shields.
5. Inspect condition of exhaust system hangers, brackets, clamps, and heat shields.
6. Check and refill diesel exhaust fluid (DEF).

EP-E. Emissions Control Systems

1. Identify emission control system components and configurations.
2. Inspect, test, and service, and/or replace positive crankcase ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses.

IX. FOUNDATIONAL TASKS (GT)

GT-A. Shop and Personal Safety

1. Identify general shop safety rules and procedures.
2. Utilize safe procedures for handling of tools and equipment.
3. Identify and use proper placement of floor jacks and jack stands.
4. Identify and use proper procedures for safe lift operation.
5. Utilize proper ventilation procedures for working within the lab/shop area.
6. Identify marked safety areas.
7. Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment.
8. Identify the location and use of eye wash stations.
9. Identify the location of the posted evacuation routes.
10. Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities.
11. Identify and wear appropriate clothing for lab/shop activities.
12. Secure hair and jewelry for lab/shop activities.
13. Identify vehicle systems which pose a safety hazard during service such as: supplemental restraint systems (SRS), electronic brake control systems, stop/start systems, and remote start systems.
14. Identify vehicle systems which pose a safety hazard during service due to high voltage such as: hybrid/electric drivetrain, lighting systems, ignition systems, A/C systems, injection systems, etc.
15. Locate and demonstrate knowledge of safety data sheets (SDS).

GT-B. Tools and Equipment

1. Identify tools and their usage in automotive applications.
2. Identify standard and metric designation.
3. Demonstrate safe handling and use of appropriate tools.
4. Demonstrate proper cleaning, storage, and maintenance of tools and equipment.
5. Demonstrate proper use of precision measuring tools (e.g., micrometer, dial-indicator, dial-caliper).
6. Perform common fastener and thread repair, including removing broken bolts, restoring internal and external threads, and repairing internal threads with a thread insert.

GT-C. Preparing Vehicle for Service

1. Identify the information needed and the service requested on a repair order.
2. Identify purpose and demonstrate proper use of vehicle protection such as: fender covers, mats, seat, and steering wheel covers.
3. Perform a vehicle walk-around inspection; identify and document existing vehicle conditions such as body damage, paint damage, windshield damage.
4. Perform a vehicle multi-point inspection and complete a vehicle inspection report.
5. Demonstrate use of the three C's (concern, cause, and correction).
6. Create a plan of action for each specific service or diagnostic situation.

7. Review vehicle service history.
8. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

GT-D. Preparing Vehicle for Customer

1. Ensure vehicle is prepared to return to customer per school/company policy (floor mats, steering wheel cover, etc.).

AUTOMOBILE SERVICE TECHNOLOGY (AS)

Test Specification

Content Area	Questions in Test
A. Engine Repair (ER)	9
B. Automatic Transmission and Transaxle (AT)	6
C. Manual Drive Train and Axles (MD)	6
D. Suspension and Steering (SS)	11
E. Brakes (BR)	11
F. Electrical/Electronic Systems (EE)	13
G. Heating, Ventilation, And Air Conditioning (AC)	7
H. Engine Performance (EP)	11
I. Foundational Tasks (GT)	6
Required To Pass: 45	TOTAL 80

Task List

I. ENGINE REPAIR

ER-A. General: Engine Diagnosis

1. Research vehicle service information such as fluid type, internal combustion engine operation, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
3. Verify operation of the instrument panel engine warning indicators.
4. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine needed action.
5. Install engine covers using gaskets, seals, and sealers as required.
6. Verify engine mechanical timing.
7. Inspect, remove, and/or replace engine mounts.
8. Identify service precautions related to service of the internal combustion engine of a hybrid electric vehicle.

ER-B. Cylinder Head and Valve Train

1. Identify cylinder head and valve train components and configurations.

2. Remove cylinder head; inspect gasket condition; install cylinder head and gasket; tighten according to manufacturer's specification and procedure.
3. Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition.
4. Inspect valve actuating mechanisms for wear, bending, cracks, looseness, and blocked oil passages (orifices); determine needed action.
5. Adjust valves (mechanical or hydraulic lifters).
6. Inspect and replace camshaft and drive belt/chain; includes checking drive gear wear and backlash, end play, sprocket and chain wear, overhead cam drive sprocket(s), drive belt(s), belt tension, tensioners, camshaft reluctor ring/tone-wheel, and valve timing components; verify correct camshaft timing.

ER-C. Engine Block Assembly

1. Identify engine block assembly components and configurations.
2. Remove, inspect, and/or replace crankshaft vibration damper (harmonic balancer).

ER-D. Lubrication and Cooling Systems

1. Identify lubrication and cooling system components and configurations.
2. Perform engine oil and filter change; use proper fluid type per manufacturer specification; reset maintenance reminder as required.
3. Perform cooling system pressure and dye tests to identify leaks; check coolant condition and level; inspect and test radiator, pressure cap, coolant recovery tank, heater core, and galley plugs; determine needed action.
4. Identify causes of engine overheating.
5. Inspect, replace, and/or adjust drive belts, tensioners, and pulleys; check pulley and belt alignment.
6. Inspect and test coolant; drain and recover coolant; flush and/or refill cooling system; use proper fluid type per manufacturer specification; bleed air as required.
7. Inspect, remove, and replace the water pump.
8. Remove, inspect, and replace thermostat and gasket/seal.
9. Remove and replace radiator.
10. Inspect and test fan(s), fan clutch (electrical or mechanical), fan shroud, and air dams; determine needed action.
11. Perform oil pressure tests; determine needed action.
12. Inspect auxiliary coolers; determine needed action.
13. Inspect, test, and/or replace oil temperature and pressure switches and sensors.

II. AUTOMATIC TRANSMISSION AND TRANSAXLE

AT-A. General: Transmission and Transaxle Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify automatic transmission and transaxle components and configurations.

3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle equipped with a dipstick.
5. Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle not equipped with a dipstick.
6. Diagnose transmission/transaxle gear reduction/multiplication concerns using driving, driven, and held member (power flow) principles.
7. Diagnose pressure concerns in a transmission using hydraulic principles (Pascal's Law).
8. Identify and interpret transmission/transaxle concerns, differentiate between engine performance and transmission/transaxle concerns; determine needed action.
9. Diagnose fluid loss and condition concerns; determine needed action.
10. Perform stall test; determine needed action.
11. Perform lock-up converter system tests; determine needed action.
12. Perform pressure tests on transmissions/transaxles equipped with electronic pressure control; determine needed action.

AT-B. In-Vehicle Transmission/Transaxle

1. Inspect, adjust, and/or replace external manual valve shift linkage, transmission range sensor/switch, and/or park/neutral position switch.
2. Drain and replace fluid and filter(s); use proper fluid type per manufacturer specification.
3. Perform relearn procedures.
4. Inspect, replace and/or align power train mounts.
5. Inspect for leakage; replace external seals, gaskets, and bushings.
6. Inspect, test, adjust, repair, and/or replace electrical/electronic components and circuits.

AT-C. Off-Vehicle Transmission and Transaxle

1. Describe the operational characteristics of a continuously variable transmission (CVT).
2. Describe the operational characteristics of a hybrid vehicle drive train.
3. Remove and reinstall transmission/transaxle and torque converter; inspect engine core plugs, rear crankshaft seal, dowel pins, dowel pin holes, and mating surfaces.
4. Inspect, leak test, flush, and/or replace transmission/transaxle oil cooler, lines, and fittings.
5. Inspect converter flex (drive) plate, converter attaching bolts, converter pilot, converter pump drive surfaces, converter end play, and crankshaft pilot bore.

III. MANUAL DRIVE TRAIN AND AXLES

MD-A. General: Drive Train Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify manual drive train and axles components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.

4. Check fluid condition; check for leaks; determine needed action.
5. Drain and refill manual transmission/transaxle; use proper fluid type per manufacturer specification.
6. Diagnose drive train concerns; determine needed action.

MD-B. Clutch

1. Check and adjust clutch master cylinder fluid level; check for leaks; use proper fluid type per manufacturer specification.
2. Diagnose clutch noise, binding, slippage, pulsation, and chatter; determine needed action.
3. Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; determine needed action.
4. Inspect and/or replace clutch pressure plate assembly, clutch disc, release (throw-out) bearing, linkage, and pilot bearing/bushing (as applicable).
5. Bleed clutch hydraulic system.
6. Inspect flywheel and ring gear for wear and cracks, and discoloration; determine needed action.
7. Measure flywheel runout and crankshaft end play; determine needed action.
8. Describe the operation and service of a system that uses a dual mass flywheel.

MD-C. Transmission/Transaxle

1. Describe the operational characteristics of an electronically controlled manual transmission/transaxle.
2. Inspect, adjust, lubricate, and/or replace shift linkages, brackets, bushings, cables, pivots, and levers.

MD-D. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair (Front, Rear, All-wheel, Four-wheel drive)

1. Inspect and/or remove/replace bearings, hubs, and seals.
2. Inspect and/or service/replace shafts, yokes, boots, and universal/CV joints.
3. Check for leaks at drive assembly and transfer case seals; check vents; check fluid level; use proper fluid type per manufacturer specification.
4. Diagnose constant-velocity (CV) joint noise and vibration concerns; determine needed action.
5. Diagnose universal joint noise and vibration concerns; determine needed action.
6. Check shaft balance and phasing; measure shaft runout; measure and adjust driveline angles; determine needed action.

MD-E. Drive Axle Diagnosis and Repair

E.1 Ring and Pinion Gears and Differential Housing Assembly

1. Inspect differential housing; check for leaks; inspect housing vent.
2. Check and adjust differential housing fluid level; use proper fluid type per manufacturer specification.
3. Drain and refill differential housing; using proper fluid type per manufacturer specification.
4. Inspect and replace companion flange and/or pinion seal; measure companion flange runout.

5. Demonstrate knowledge of drive pinion and ring gear service and set up including depth, preload, backlash, and gear tooth contact.

E.2 Drive Axles

1. Inspect and replace drive axle wheel studs.
2. Remove and replace drive axle shafts.
3. Inspect and replace drive axle shaft seals, bearings, and retainers.
4. Measure drive axle flange runout and shaft end play; determine needed action.

MD-F. Four-wheel Drive/All-wheel Drive

1. Identify concerns related to variations in tire circumference and/or final drive ratios.
2. Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets.
3. Inspect axle locking mechanisms; determine needed action(s).
4. Check for leaks at drive assembly and transfer case seals; check vents; check fluid level; use proper fluid type per manufacturer specification.

IV. SUSPENSION AND STEERING

SS-A. General: Suspension and Steering Systems

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify suspension and steering system components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Disable and enable supplemental restraint system (SRS); verify indicator lamp operation.
5. Identify and interpret suspension and steering system concerns; determine needed action.

SS-B. Steering Systems

1. Inspect rack and pinion steering gear tie rod ends (sockets) and bellows boots; repair or replace as needed.
2. Inspect power steering fluid level and condition.
3. Drain and replace power steering system fluid; use proper fluid type per manufacturer specification.
4. Inspect for power steering fluid leakage; determine needed action.
5. Remove, inspect, replace, and/or adjust power steering pump drive belt.
6. Inspect, remove, and/or replace power steering hoses and fittings.
7. Inspect, remove, and/or replace pitman arm, relay (centerlink/intermediate) rod, idler arm, mountings, and steering linkage damper.
8. Inspect, replace, and/or adjust tie rod ends (sockets), tie rod sleeves, and clamps (non-rack and pinion).
9. Inspect and test electric power steering system; determine needed action.

10. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil (clock spring).
11. Diagnose steering column noises, looseness, and binding concerns (including tilt/telescoping mechanisms); determine needed action.
12. Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine needed action.
13. Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine needed action.
14. Inspect steering shaft universal joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; determine needed action.
15. Remove and replace rack and pinion steering gear; inspect mounting bushings and brackets.
16. Remove and reinstall power steering pump.
17. Remove and reinstall press fit power steering pump pulley; check pulley and belt alignment.

SS-C. Suspension Systems

1. Inspect, remove, and/or replace upper and/or lower control arms, bushings, and shafts.
2. Inspect and replace rebound/jounce bumpers.
3. Inspect, remove, and/or replace track bar, strut rods/radius arms, and related mounts and bushings.
4. Inspect, remove, and/or replace upper and/or lower ball joints (with or without wear indicators).
5. Inspect, remove, and/or replace suspension system coil springs and spring insulators.
6. Inspect, remove, and/or replace torsion bars and mounts.
7. Inspect, remove, and/or replace front/rear stabilizer bar (sway bar) bushings, brackets, and links.
8. Inspect, remove, and/or replace strut assembly, strut coil spring, insulators, and upper strut bearing mount.
9. Inspect, remove, and/or replace components of suspension systems (Coil, Leaf, and Torsion).
10. Inspect, remove, and/or replace components of electronically controlled suspension systems.
11. Inspect, remove, and/or replace steering knuckle assemblies.
12. Diagnose suspension system noises, body sway, and uneven ride height concerns; determine needed action.

SS-D. Related Suspension and Steering Service

1. Inspect, remove, and/or replace shock absorbers; inspect mounts and bushings.
2. Inspect, service, and/or replace front and rear wheel bearings.
3. Describe the function of electronically controlled suspension and steering systems and components, (i.e., active suspension and stability control).

SS-E. Wheel Alignment

1. Perform pre-alignment inspection; measure vehicle ride height; determine needed action.
2. Describe four-wheel alignment angles (camber, caster, and toe) and effects on vehicle handling\tire wear.
3. Prepare vehicle for wheel alignment on alignment machine; perform four-wheel alignment by checking and adjusting front caster, front and rear camber, and toe as required; center steering wheel.

4. Check toe-out-on-turns (turning radius); determine needed action.
5. Check steering axis inclination (SAI) and included angle; determine needed action.
6. Check rear wheel thrust angle; determine needed action.
7. Check for front wheel setback; determine needed action.
8. Identify front and/or rear cradle (subframe) misalignment; determine needed action.
9. Reset steering angle sensor.
10. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine needed action.

SS-F. Wheels and Tires

1. Inspect tire condition/age; identify tire wear patterns; check for correct tire size, application (service-class, load, and speed ratings), and air pressure as listed on the tire information placard/label.
2. Rotate tires according to manufacturer's recommendation including vehicles equipped with tire pressure monitoring system (TPMS).
3. Dismount, inspect, and remount tire on wheel (with/without TPMS); balance wheel and tire assembly.
4. Inspect tire and wheel assembly for air loss; determine needed action.
5. Repair tire following tire manufacturer approved procedure.
6. Identify indirect and direct tire pressure monitoring systems (TPMS); calibrate/relearn system; verify operation of instrument panel lamps.
7. Demonstrate knowledge of steps required to remove and replace sensors (per OEM/sensor manufacturer) in a tire pressure monitoring system (TPMS).
8. Perform Road Force balance/match mounting.
9. Diagnose wheel/tire vibration, shimmy, and noise; determine needed action.
10. Measure wheel, tire, axle flange, and hub runout; determine needed action.
11. Diagnose tire pull problems; determine needed action.

V. BRAKES

BR-A. General: Brake System Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify brake system components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Describe procedure for performing a road test to check brake system operation, including an anti-lock brake system (ABS).
5. Install wheel and torque lug nuts.
6. Identify and interpret brake system concerns; determine needed action.

BR-B. Hydraulic System

1. Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's Law).

2. Measure brake pedal height, travel, and free play (as applicable); determine needed action.
3. Check master cylinder for internal/external leaks and proper operation; determine needed action.
4. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, wear, and loose fittings/supports; determine needed action.
5. Select, handle, store, and fill brake fluids to proper level; use proper fluid type per manufacturer specification.
6. Identify components of hydraulic brake warning light system.
7. Bleed and/or replace fluid in the brake system.
8. Test brake fluid for contamination.
9. Remove, bench bleed, and reinstall master cylinder.
10. Diagnose poor stopping, pulling, or dragging concerns caused by malfunctions in the hydraulic system; determine needed action.
11. Replace brake lines, hoses, fittings, and supports.
12. Fabricate brake lines using proper material and flaring procedures.
13. Inspect, test, and/or replace components of brake warning light system.

BR-C. Drum Brakes

1. Remove, clean, and inspect brake drum; measure brake drum diameter; determine serviceability.
2. Refinish brake drum and measure final drum diameter; compare with specification.
3. Remove, clean, inspect, and/or replace brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.
4. Inspect wheel cylinders for leaks and proper operation; remove and replace as needed.
5. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments.
6. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pedal pulsation concerns; determine needed action.

BR-D. Disc Brakes

1. Remove and clean caliper assembly; inspect for leaks, damage, and wear; determine needed action.
2. Inspect caliper mounting and slides/pins for proper operation, wear, and damage; determine needed action.
3. Remove, inspect, and/or replace brake pads and retaining hardware; determine needed action.
4. Lubricate and reinstall caliper, brake pads, and related hardware; seat brake pads against rotor; inspect for leaks.
5. Clean and inspect rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine needed action.
6. Remove and reinstall/replace rotor.
7. Refinish rotor on vehicle; measure final rotor thickness and compare with specification.
8. Refinish rotor off vehicle; measure final rotor thickness and compare with specification.
9. Retract and re-adjust caliper piston on an integrated parking brake system.

10. Describe importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendation.
11. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pulsation concerns; determine needed action.

BR-E. Power-Assist Units

1. Check brake pedal travel with and without engine running to verify proper power booster operation.
2. Identify components of the brake power assist system (vacuum/ hydraulic/electric).
3. Inspect vacuum-type power booster unit for leaks; inspect the check-valve for proper operation; check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster; determine needed action.
4. Inspect and test hydraulically assisted power brake system for leaks and proper operation; determine needed action.

BR-F. Related Systems (i.e., Wheel Bearings, Parking Brakes, Electrical)

1. Remove, clean, inspect, repack/replace, and install wheel bearings; remove and install bearing races; replace seals; install hub and adjust bearings.
2. Check parking brake system components for wear, binding, and corrosion; clean, lubricate, adjust and/or replace as needed.
3. Check parking brake operation (including electric parking brakes); check parking brake indicator light system operation; determine needed action.
4. Check operation of brake stop light system.
5. Inspect and replace wheel studs.
6. Remove, reinstall, and/or replace sealed wheel bearing assembly.
7. Diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine needed action.

BR-G. Electronic Brake Control Systems: Antilock Brake (ABS), Traction Control (TCS) and Electronic Stability Control (ESC) Systems

1. Identify and inspect electronic brake control system components and describe function (ABS, TCS, ESC); determine needed action.
2. Describe the operation of a regenerative braking system.
3. Bleed the electronic brake control system hydraulic circuits.

VI. ELECTRICAL/ELECTRONIC SYSTEMS

EE-A. General: Electrical System Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify electrical/electronic system components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.

4. Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law).
5. Demonstrate proper use of a digital multimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow and resistance.
6. Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits.
7. Describe types of test lights; use appropriate test light to check operation of electrical circuits as directed per service information.
8. Use fused jumper wires to check operation of electrical circuits per service information.
9. Use wiring diagrams during the diagnosis of electrical/electronic circuit problems.
10. Diagnose the cause(s) of excessive key-off battery drain (parasitic draw); determine needed action.
11. Inspect and test fusible links, circuit breakers, and fuses; determine needed action.
12. Inspect, test, repair, and/or replace components, connectors, terminals, harnesses, and wiring in electrical/electronic systems (including solder repairs); determine needed action.
13. Test and measure circuit using an oscilloscope and/or graphing multimeter (GMM); interpret results; determine needed action.

EE-B. Batteries (Conventional 12-volt)

1. Perform battery state-of-charge test; determine needed action.
2. Confirm proper battery capacity, size, type, and application for vehicle; perform battery capacity and load test; determine needed action.
3. Maintain or restore electronic memory functions as recommended by manufacturer.
4. Inspect and clean battery; fill battery cells (if applicable); check battery cables, connectors, clamps, and hold-downs.
5. Perform battery charging according to manufacturer's recommendations.
6. Jump-start vehicle using jumper cables and a booster battery or an auxiliary power supply.
7. Identify electrical/electronic modules, security systems, radios, and other accessories that require reinitialization or code entry after reconnecting vehicle battery.

EE-C. Starting System

1. Perform starter current draw test; determine needed action.
2. Perform starter circuit voltage drop tests; determine needed action.
3. Inspect and test starter relays and solenoids; determine needed action.
4. Remove and install starter in a vehicle.
5. Inspect and test switches, connectors, and wires of starter control circuits; determine needed action.
6. Demonstrate knowledge of automatic idle-stop/start-stop systems.
7. Differentiate between electrical and engine mechanical problems that cause a slow-crank or a no-crank condition.
8. Diagnose a no-crank condition using a wiring diagram and test equipment; determine needed action.

EE-D. Charging System

1. Perform charging system output test; determine needed action.
2. Inspect, adjust, and/or replace generator (alternator) drive belts; check pulleys and tensioners for wear; check pulley and belt alignment; determine needed action.
3. Remove, inspect, and/or replace generator (alternator); determine needed action.
4. Perform charging circuit voltage drop tests; determine needed action.
5. Diagnose charging system for causes of undercharge, no-charge, or overcharge conditions; determine needed action.

EE-E. Lighting Systems

1. Inspect interior and exterior lamps and sockets including headlights and auxiliary lights (fog lights/driving lights); determine needed action.
2. Aim headlights.
3. Diagnose the causes of brighter-than-normal, intermittent, dim, or no light operation; determine needed action.

EE-F. Instrument Cluster and Driver Information Systems

1. Verify operation of instrument panel gauges and warning/indicator lights; reset maintenance indicators as required.
2. Inspect and test gauges and gauge sending units for causes of abnormal readings; determine needed action.
3. Diagnose the causes of incorrect operation of warning devices and other driver information systems; determine needed action.

EE-G. Body Electrical Systems Diagnosis and Repair

1. Diagnose vehicle comfort, convenience, access, safety, and related systems operation; determine needed action.
2. Remove and reinstall door panel.
3. Diagnose operation of security/anti-theft systems and related circuits (such as: theft deterrent, door locks, remote keyless entry, remote start, and starter/fuel disable); determine needed action.
4. Describe disabling and enabling procedures for supplemental restraint system (SRS); verify indicator lamp operation.
5. Verify windshield wiper and washer operation; replace wiper blades.
6. Diagnose operation of entertainment and related circuits (such as: radio, DVD, remote CD changer, navigation, amplifiers, speakers, antennas, and voice-activated accessories); determine needed action.
7. Diagnose operation of safety systems and related circuits (such as: horn, airbags, seat belt pretensioners, occupancy classification, wipers, washers, speed control/collision avoidance, heads-up display, parking assist, and back-up camera); determine needed action.
8. Diagnose body electronic system circuits using a scan tool; check for module communication errors (data communication bus systems); determine needed action.

9. Describe the process for software transfer, software updates, or reprogramming of electronic modules.

VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

AC-A. General: A/C System Diagnosis and Repair

1. Research vehicle service information, including refrigerant/oil/fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify heating, ventilation, and air conditioning (HVAC) components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Perform A/C system performance test; interpret results; determine needed action.
5. Identify abnormal operating noises in the A/C system; determine needed action.
6. Leak test A/C system; determine needed action.
7. Identify and interpret heating and air conditioning problems; determine needed action.
8. Identify refrigerant type; test for sealant; select and connect proper gauge set/test equipment; record temperature and pressure readings.
9. Inspect condition/quantity of refrigerant oil removed from A/C system; determine needed action.
10. Determine recommended oil and oil capacity for system application and component(s) replacement.

AC-B. Refrigeration System Components

1. Inspect, remove, and/or replace A/C compressor drive belts, pulleys, and tensioners; determine needed action.
2. Inspect for proper A/C condenser airflow; determine needed action.
3. Inspect evaporator housing condensation drain; determine needed action.
4. Inspect, test, and/or service A/C compressor clutch components and/or assembly; determine needed action.
5. Remove, inspect, and reinstall, and/or replace A/C compressor and mountings; determine recommended oil type and quantity.
6. Remove and inspect A/C system mufflers, hoses, lines, fittings, O-rings, seals, and service valves; determine needed action.
7. Remove, inspect, and reinstall replace receiver/drier or accumulator/drier; determine recommended oil type and quantity.
8. Remove, inspect, and install expansion valve or orifice (expansion) tube.
9. Diagnose A/C system conditions that cause the protection devices (pressure, thermal, and/or control module) to interrupt system operation; determine needed action.
10. Determine procedure to remove and reinstall evaporator; determine required oil type and quantity.
11. Remove, inspect, reinstall, and/or replace condenser; determine required oil type and quantity.

AC-C. Heating, Ventilation, and Engine Cooling Systems

1. Inspect engine cooling and heater systems hoses and pipes; determine needed action.
2. Inspect and test heater control valve(s); determine needed action.
3. Diagnose temperature control problems in the HVAC system related to the engine cooling system, including electric heating; determine needed action.
4. Determine procedure to remove, inspect, reinstall, and/or replace heater core; properly refill system.

AC-D. Operating Systems and Related Controls

1. Inspect HVAC system ducts, doors, hoses, cabin filters, and outlets; determine needed action.
2. Identify the source of HVAC system odors.
3. Inspect and test HVAC system blower motors, resistors, switches, relays, wiring, and protection devices; determine needed action.
4. Diagnose A/C compressor control systems; determine needed action.
5. Diagnose malfunctions in the vacuum, mechanical, and/or electrical components and controls of the HVAC system; determine needed action.
6. Inspect, test, remove and/or replace HVAC system control panel; determine needed action.
7. Check operation of automatic HVAC control systems; determine needed action.

AC-E. Refrigerant Recovery, Recycling, and Handling

1. Demonstrate awareness of the need to recover, recycle, and handle refrigerants using proper equipment and procedures.
2. Use and maintain refrigerant handling equipment according to equipment manufacturer's standards.
3. Identify A/C system refrigerant; test for sealants; recover, evacuate, and charge A/C system; add refrigerant oil as required.
4. Recycle, label, and store refrigerant.

VIII. ENGINE PERFORMANCE

EP-A. General: Engine Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
3. Verify proper engine cooling system operation; determine needed action.
4. Verify correct camshaft timing including engines equipped with variable valve timing (VVT) systems; determine needed action.
5. Identify and interpret engine performance concerns; determine needed action.
6. Diagnose abnormal engine noises or vibration concerns; determine needed action.
7. Diagnose the cause of excessive oil consumption, coolant consumption, unusual exhaust color, odor, and sound; determine needed action.
8. Perform engine manifold pressure tests (vacuum/boost); determine needed action.

9. Perform cylinder power balance test; determine needed action.
10. Perform cylinder cranking and running compression tests; determine needed action.
11. Perform cylinder leakage test; determine needed action.
12. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns; determine needed action.

EP-B. Computerized Controls

1. Identify computerized control system components and configurations.
2. Access and use service information to perform step-by-step (troubleshooting) diagnosis.
3. Perform active tests of actuators using a scan tool; determine needed action.
4. Describe the use of OBD monitors for repair verification.
5. Inspect and test computerized engine control system sensors, powertrain/engine control module (PCM/ECM), actuators, and circuits using a graphing multimeter (GMM), digital storage oscilloscope (DSO), and/or scan tool; determine needed action.
6. Describe the process for reprogramming or recalibrating the powertrain/engine control module (PCM/ECM).

EP-C. Ignition System

1. Identify ignition system components and configurations.
2. Remove and replace spark plugs; inspect secondary ignition components for wear and damage; determine needed action.
3. Diagnose ignition system related problems such as no-starting, hard starting, engine misfire, poor driveability, spark knock, power loss, poor mileage, and emissions concerns; determine needed action.
4. Inspect and test crankshaft and camshaft position sensor(s); determine needed action.
5. Inspect, test, and/or replace ignition control module and/or powertrain/engine control module; reprogram/initialize as needed.

EP-D. Fuel, Air Induction, and Exhaust Systems

1. Identify fuel, air induction, and exhaust system components and configurations.
2. Replace fuel filter(s) where applicable.
3. Inspect, service, or replace air filters, filter housings, and intake duct work.
4. Inspect integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shields; determine needed action.
5. Inspect condition of exhaust system hangers, brackets, clamps, and heat shields; determine needed action.
6. Check and refill diesel exhaust fluid (DEF).
7. Check fuel for quality, composition, and contamination; determine needed action.
8. Inspect and test fuel pump(s) and pump control system for pressure, regulation, and volume; determine needed action.
9. Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air.
10. Inspect, test, and/or replace fuel injectors on low- and high-pressure systems.
11. Verify proper idle speed; determine needed action.

12. Perform exhaust system back-pressure test; determine needed action.

EP-E. Emissions Control Systems

1. Identify emission control system components and configurations.
2. Inspect, test, service, and/or replace positive crankcase ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses; determine needed action.
3. Diagnose oil leaks, emissions, and driveability concerns caused by the positive crankcase ventilation (PCV) system; determine needed action.
4. Diagnose emissions and driveability concerns caused by the exhaust gas recirculation (EGR) system; inspect, test, service and/or replace electrical/electronic sensors, controls, wiring, tubing, exhaust passages, vacuum/pressure controls, filters, and hoses of exhaust gas recirculation (EGR) system; determine needed action.
5. Inspect and test electrical/electronically operated components and circuits of secondary air injection systems; determine needed action.
6. Diagnose emissions and driveability concerns caused by catalytic converter system; determine needed action.
7. Diagnose emissions and driveability concerns caused by the evaporative emissions control (EVAP) system; determine needed action.
8. Interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems; determine needed action.

IX. FOUNDATIONAL TASKS (GT)

GT-A. Shop and Personal Safety

1. Identify general shop safety rules and procedures.
2. Utilize safe procedures for handling of tools and equipment.
3. Identify and use proper placement of floor jacks and jack stands.
4. Identify and use proper procedures for safe lift operation.
5. Utilize proper ventilation procedures for working within the lab/shop area.
6. Identify marked safety areas.
7. Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment.
8. Identify the location and use of eye wash stations.
9. Identify the location of the posted evacuation routes.
10. Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities.
11. Identify and wear appropriate clothing for lab/shop activities.
12. Secure hair and jewelry for lab/shop activities.
13. Identify vehicle systems which pose a safety hazard during service such as: supplemental restraint systems (SRS), electronic brake control systems, stop/start systems, and remote start systems.
14. Identify vehicle systems which pose a safety hazard during service due to high voltage such as: hybrid/electric drivetrain, lighting systems, ignition systems, A/C systems, injection systems, etc.
15. Locate and demonstrate knowledge of safety data sheets (SDS).

GT-B. Tools and Equipment

1. Identify tools and their usage in automotive applications.
2. Identify standard and metric designation.
3. Demonstrate safe handling and use of appropriate tools.
4. Demonstrate proper cleaning, storage, and maintenance of tools and equipment.
5. Demonstrate proper use of precision measuring tools (e.g., micrometer, dial-indicator, dial-caliper).
6. Perform common fastener and thread repair, including removing broken bolts, restoring internal and external threads, and repairing internal threads with a thread insert.

GT-C. Preparing Vehicle for Service

1. Identify the information needed and the service requested on a repair order.
2. Identify purpose and demonstrate proper use of vehicle protection such as: fender covers, mats, seat, and steering wheel covers.
3. Perform a vehicle walk-around inspection; identify and document existing vehicle conditions such as body damage, paint damage, windshield damage.
4. Perform a vehicle multi-point inspection and complete a vehicle inspection report.
5. Demonstrate use of the three C's (concern, cause, and correction).
6. Create a plan of action for each specific service or diagnostic situation.
7. Review vehicle service history.
8. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

GT-D. Preparing Vehicle for Customer

1. Ensure vehicle is prepared to return to customer per school/company policy (floor mats, steering wheel cover, etc.).

Sample Test Questions

The following are examples of the types of questions found on the ASE Entry-Level Automobile tests. Each test will consist of a mixture of theory and applied diagnostic style questions. All of the questions below are retired test questions that were previously used on the ASE Entry-Level tests. They are an accurate reflection of the content of the tests, but none of them appear on current versions of the tests.

1. Technician A says that eye protection should be worn at all times while in the laboratory area.
Technician B says that regular prescription eye wear may be worn as a substitute for safety glasses.
Who is right?
(A) A only
(B) B only
(C) Both A and B
(D) Neither A nor B

2. The correct sequence of strokes (events) in a four-cycle engine is:
(A) compression, intake, power, exhaust.
(B) exhaust, intake, compression, power.
(C) power, intake, exhaust, compression.
(D) intake, compression, exhaust, power.

3. The 10th position on the illustrated vehicle identification number (VIN) indicates the:
(A) engine package.
(B) transmission type.
(C) model year.
(D) assembly plant.

4. An engine does not reach operating temperature while being driven. Which of these could be the cause?
(A) A stuck-closed thermostat
(B) A stuck-open thermostat
(C) A slipping water pump belt
(D) A clogged radiator passage

5. An oil pressure sensor is being replaced.
Technician A says that the electrical connector should be inspected for oil contamination.
Technician B says that the oil level sensor should be replaced at the same time.
Who is right?
(A) A only
(B) B only
(C) Both A and B
(D) Neither A nor B

6. Blue exhaust smoke can be caused by:
(A) a clogged air filter.
(B) worn piston rings.
(C) worn main bearings.
(D) a blown head gasket.

7. The torque sequence for cylinder head bolts normally begins at the:
(A) middle of the head.
(B) front of the head.
(C) side of the head closest to the intake manifold.
(D) rear of the head.

8. An engine cooling system thermostat is being replaced.
Technician A says that a thermostat with a lower opening temperature may be installed to correct an overheating problem.
Technician B says that a thermostat equipped with a bleed hole or valve needs to be orientated in the housing during installation.
Who is right?
(A) A only
(B) B only
(C) Both A and B
(D) Neither A nor B

9. Technician A says that the number on the bolt head in the illustration indicates its diameter.
Technician B says that that the number on the bolt head in the illustration indicates its thread pitch.
Who is right?
(A) A only
(B) B only
(C) Both A and B
(D) Neither A nor B

10. Prior to replacing an automatic transmission filter on most vehicles, a technician should:
(A) remove the pan.
(B) clean all spool valves in the valve body.
(C) drain the converter.
(D) disconnect the converter clutch solenoid.

11. While changing the transmission fluid, a technician notices that the fluid is milky and pink. This could be caused by:
(A) using an incorrect fluid.
(B) an overfilled transmission.
(C) a cracked transmission cooler.
(D) a split torque converter seal.

12. Which of these could cause a manual transaxle to jump out of gear?
(A) A misadjusted clutch
(B) Worn CV joints
(C) A binding clutch release bearing
(D) Worn shifter forks

13. The transfer case rear output seal is leaking on a vehicle equipped with four-wheel drive.
Technician A says that the transfer case should be removed to access the seal.
Technician B says that the transfer case drive chain should be removed to access the seal.
Who is right?
(A) A only
(B) B only
(C) Both A and B
(D) Neither A nor B

This question uses the words LEAST LIKELY. Look for the choice that could NOT or would be LEAST LIKELY to cause the described situation. Read the entire question carefully before choosing your answer.

14. The clutch does not release fully when the pedal is pushed to the floor. Which of these is the LEAST LIKELY cause?
(A) Weak pressure plate springs
(B) Too much pedal free travel
(C) A warped clutch disc
(D) A seized pilot bearing

15. Two meshed gears have a gear ratio of 1.5 : 1. If the smaller gear has 12 teeth, how many teeth should the larger gear have?
(A) 9 teeth
(B) 12 teeth
(C) 18 teeth
(D) 24 teeth

16. During a road test a technician notes excessive vehicle body roll. This could be caused by:
(A) worn pitman arm.
(B) worn stabilizer bar bushings and links.
(C) worn upper control arms.
(D) loose wheel bearings.

17. A power steering rack and pinion is being replaced.
Technician A says that the toe will need to be reset after the replacement rack is installed.
Technician B says that service information specific to the replacement rack may be included in the new rack packaging.
Who is right?
(A) A only
(B) B only
(C) Both A and B
(D) Neither A nor B

18. The ride height on the rear of a vehicle is found to be too low. The best corrective action would be to:
(A) replace the rear shocks.
(B) install larger diameter rear tires.
(C) replace the rear springs.
(D) add helper springs.

19. In a parallelogram steering linkage, which of these supports the center link?
(A) Inner and outer tie rods
(B) Idler arm and pitman arm
(C) Steering coupler
(D) Strut rods

20. The role of a stabilizer (anti-sway) bar is to:
(A) prevent vibration.
(B) control body roll.
(C) prevent tire wear.
(D) absorb noise.

21. The light in the illustration shown is illuminated on the dash, this indicates a problem in the:
(A) electric parking brake system.
(B) electric power steering system.
(C) engine protection system.
(D) environmental protection system.

22. A vehicle pulls to the left while driving. Which of these should a technician check first?
(A) Wheel alignment
(B) Tire pressure
(C) Power steering fluid level
(D) Power steering pump pressure

23. A vehicle wanders when traveling on a smooth and level highway. The alignment is within specifications.
Technician A says that the vehicle service history should be researched.
Technician B says that a search should be made for related service bulletins.
Who is right?
(A) A only
(B) B only
(C) Both A and B
(D) Neither A nor B

24. A vehicle with front disc brakes shudders when the brakes are applied. Which of these could be the cause?
(A) Worn disc pads
(B) A leaking grease seal
(C) Warped brake rotors
(D) A tight wheel bearing

25. A front disc brake rotor is slightly below minimum thickness specification after machining. The technician should:
(A) reuse the rotor.
(B) replace the rotor.
(C) apply a non-directional finish to the rotor.
(D) machine the other front rotor to the same thickness.

26. The brake pedal goes to the floor when depressed (applied).
Technician A says that this could be caused by a faulty master cylinder.
Technician B says that this could be caused by a faulty ABS control module.
Who is right?
(A) A only
(B) B only
(C) Both A and B
(D) Neither A nor B

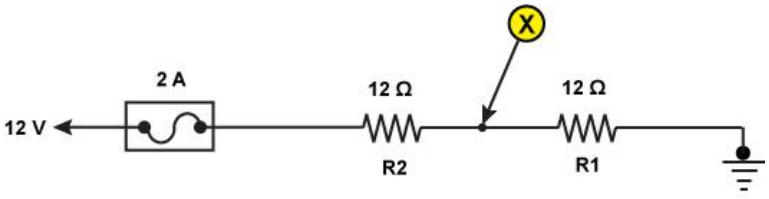
27. A vehicle with rear drum brakes has a low service brake pedal and excessive parking brake pedal/lever travel.
Technician A says that improper parking brake cable adjustment could be the cause.
Technician B says that improper rear brake shoe adjustment could be the cause.
Who is right?
(A) A only
(B) B only
(C) Both A and B
(D) Neither A nor B

28. Technician A says that an open-circuit voltage of 12.6 volts indicates a fully-charged battery.
Technician B says that a specific gravity reading of 1.265 indicates a fully-charged battery.
Who is right?
(A) A only
(B) B only
(C) Both A and B
(D) Neither A nor B

29. Charging system voltage drop should:
(A) exceed 0.5 volts.
(B) not exceed 0.5 volts.
(C) exceed 5 volts.
(D) not exceed 5 volts.

30. A vehicle has dim headlights, slow flashing turn signals, and higher than normal effort required for the power steering. Which of these could be the cause?
(A) An overcharging generator (alternator)
(B) A shorted rectifier bridge
(C) A shorted turn signal switch
(D) A slipping accessory drive belt

31. A high intensity discharge (HID) headlight system is being inspected.
Technician A says that the HID ballast unit can pose an electrical shock hazard.
Technician B says that halogen bulbs are used in HID systems.
Who is right?
(A) A only
(B) B only
(C) Both A and B
(D) Neither A nor B



32. In the circuit shown, what would happen if point X was shorted to ground?
(A) Amperage would decrease
(B) Resistance would increase
(C) Resistance would decrease
(D) Voltage would increase

33. Which of these should be used when performing a "key off" (parasitic) battery draw test?
(A) Ohmmeter
(B) Ammeter
(C) Voltmeter
(D) Digital oscilloscope

34. How many amps will flow through a circuit with 3.3 ohms of resistance if 14.0 volts are applied?
(A) 0.23 amps
(B) 4.24 amps
(C) 14.0 amps
(D) 46.2 amps

35. A vehicle repeatedly has a dead battery.
Technician A says that parasitic draw could be the cause.
Technician B says that a battery with an incorrect CCA rating could be the cause.
Who is right?
(A) A only
(B) B only
(C) Both A and B
(D) Neither A nor B

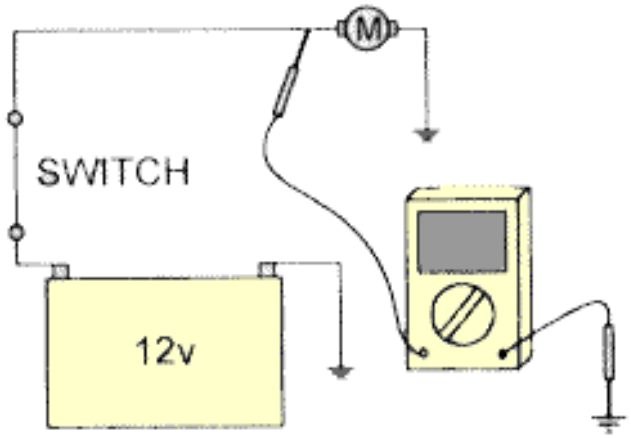


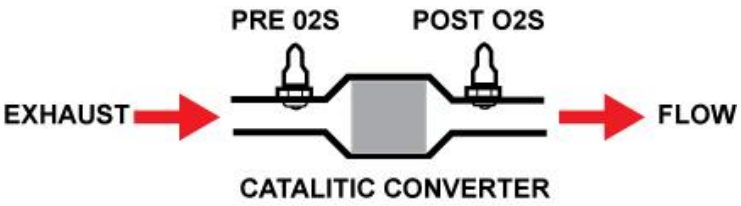
Diagram A

36. The digital multimeter (DMM) shown in Diagram A is measuring:
(A) volts.
(B) amps.
(C) ohms.
(D) watts.

37. An air conditioning system is being charged.
Technician A says that R-12 and R-134a can be mixed in a vehicle's system.
Technician B says that it is acceptable to release R-134a into the atmosphere.
Who is right?
(A) A only
(B) B only
(C) Both A and B
(D) Neither A nor B

38. In a properly operating A/C system, the compressor inlet should feel:
(A) cold and the outlet should feel hot.
(B) warm and the outlet should feel cool.
(C) hot and the outlet should feel cold.
(D) cool and the outlet should feel warm.

39. The most common cause of low pressure readings on both the high side and low side of an A/C system is a:
(A) restricted condenser air flow.
(B) low system oil charge.
(C) damaged A/C compressor.
(D) low system refrigerant charge.



40. The purpose of the illustrated post oxygen sensor is to monitor:
(A) catalytic converter operation.
(B) fuel control operation.
(C) secondary air system operation.
(D) EGR system operation.

Answer Key:

1. A	11. C	21. B	31. A
2. B	12. D	22. B	32. C
3. C	13. D	23. C	33. B
4. B	14. A	24. C	34. B
5. A	15. C	25. B	35. A
6. B	16. B	26. A	36. A
7. A	17. C	27. B	37. D
8. B	18. C	28. C	38. A
9. D	19. B	29. B	39. D
10. A	20. B	30. D	40. A