# THE OFFICIAL ASE STUDY GUIDE

# ASE Automobile Tests



INCLUDES LIGHT VEHICLE/CNG, EXHAUST SYSTEMS, AUTO SERVICE CONSULTANT TESTS!



# **ASE A**UTOMOBILE TESTS

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# **O**VERVIEW

#### Introduction

The Official ASE Study Guide of Automobile Tests is intended to help technicians study for the ASE certification tests. The information in this booklet covers the technology found in most all of today's automobiles, sport utility vehicles, and light trucks. The specific information about each test, found in the following pages, should prove to be a useful tool for reviewing the technical knowledge that is covered in the Automobile tests. After performing a thorough review, it should be easier to select additional reference material that will assist you with your test preparation needs.

ASE voluntary certification is a means through which technicians can prove their abilities to themselves, to their employers, and to their customers. By passing ASE tests you will earn the most valuable credential available to automotive technicians. Because the tests are tough, you'll have the satisfaction of proving to yourself that you are among the elite in your profession. What's more, these credentials are recognized throughout the nation.

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?**

There are nine tests in the Automobile Technician certification series. If you pass one or more tests, and have at least two years of hands-on working experience in automotive repair, you will become certified as an ASE Automobile Technician. If you pass tests A1 through A8 and meet the experience requirement, you will earn the certificate of Master Automobile Technician. Note: Test A9 is not required for Master Automobile Technician status. (Appropriate vocational training may be substituted for up to one year of work experience.)

If you are currently certified in Diesel Engines (A9, H2, S2, or T2) and Electrical/Electronic Systems (A6, H6, S6, or T6), you are eligible to take the L2 Electronic Diesel Engine Diagnosis Specialist test.

# OVERVIEW (CONTINUED)

ASE tests and certifies technicians in the following areas of specialization (the Test Content section of this booklet has a detailed list of content areas covered in each test):

#### **Automobile Tests**

- Engine Repair (Test A1)
- Automatic Transmission/Transaxle (Test A2)
- Manual Drive Train and Axles (Test A3)
- Suspension and Steering (Test A4)
- Brakes (Test A5)
- Electrical/Electronic Systems (Test A6)
- Heating and Air Conditioning (Test A7)
- Engine Performance (Test A8)
- Light Vehicle Diesel Engines (Test A9)

#### **Service Consultant Test**

• Automobile Service Consultant (Test C1)

#### Alternate Fuels

• Compressed Natural Gas Vehicle (Test F1)

#### **Specialty Tests**

• Exhaust Systems (Test X1)

You will become an Undercar Specialist when you pass the XI test and meet the following requirements. You must be currently certified (including the two-year experience requirement) in the ASE Suspension and Steering (A4) and Brakes (A5) areas BEFORE you will be permitted to register and take the X1 test. If your A4 and/or A5 certification has expired, you may NOT register for the X1 test until after you have renewed your A4 and A5 certification.

ASE also offers certification in Medium/Heavy Truck, Truck Equipment, School Bus, Transit Bus, Collision Repair/Refinish, Parts Specialist, and Advanced Level specialties. Separate *Study Guides* are available.

For full information on ASE testing as well as downloadable *Study Guides*, *Registration Booklets*, and more, visit www.ase.com. You may also request *Registration Booklets* by mailing the coupon located on the back cover of this booklet or by calling ASE at 703-669-6600, ext. 400.

#### Who Writes the Questions?

The questions, written by service industry experts familiar with all aspects of automobile repair, are entirely job-related. They are designed to test the skills that you need to know in servicing automobiles; theoretical knowledge is not covered.

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

From there, all questions are pre-tested and quality-checked on a national sample of technicians. Those questions that meet ASE standards of quality and accuracy are included in the scored sections of the tests; the "rejects" are sent back to the drawing board or discarded altogether.

Each certification test is made up of between forty and eighty multiplechoice questions. The pencil and paper testing sessions are 4 hours and 15 minutes long, allowing plenty of time to complete several tests.

*Note:* Each test could contain up to 15 additional questions that are included for statistical research purposes only. Your answers to these questions will not affect your score, but since you do not know which ones they are, you should answer all questions in the test. The five-year Recertification Test will cover the same content areas as those listed above. However, the number of questions in each content area of the Recertification Test will be reduced by about one-half.

# How Do I Prepare for the ASE Tests?

Become familiar with test content and question format: The Test Specifications in this booklet contain a summary description of the content covered by each test. The Task Lists describe the actual work performed by technicians in each specialty area. Together, these form a "blueprint" for writing and assembling the ASE tests.

Please note that each question on the test is keyed, or linked, to a particular task or set of tasks in the task list. Therefore, a review of the task lists, with an eye to judging whether you know how to perform each task listed, will provide you valuable information as you prepare for the tests.

There are five types of multiple-choice questions on the tests, each of which is included in the sample questions in this booklet. Note the different instructions for each question type.

# OVERVIEW (CONTINUED)

Be sure to read each question carefully, (twice, if necessary) 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.** Study the content list for each test you will attempt.
- Step 2. Carefully read 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 area(s) where you need additional study.

# Types of Knowledge Measured By the Tests

The types of knowledge and skills you will need to know to pass the tests are as follows:

- Basic technical knowledge: Tests your knowledge of what is in a system and how the system works, and what are the proper procedures and precautions to be followed in making repairs and adjustments.
- Service or repair knowledge and skill: Tests your understanding and ability
  to apply generally accepted repair procedures and precautions in assembly,
  disassembly, and reconditioning operations; and in making inspections and
  adjustments. Also tests your ability to use shop manuals and precision tools
  of the trade.
- Testing and diagnostic knowledge and skill: Tests your ability to recognize
  problems and to use generally available measurement and testing equipment
  to make a diagnosis. Also tests your ability to trace the effects of a particular
  condition and find the cause of a particular set of symptoms.

If you are an experienced and knowledgeable technician, a careful review of this booklet, and additional brush-up on those areas in which you are weakest, is all you should need to pass the ASE tests.

### Before The Tests

Try to be well-rested for the test so you will be alert and efficient. If you are taking the written versions, please bring several sharpened soft-lead (#2) pencils and an eraser with you; pencils will not be furnished at the test center. If you wish to pace yourself, bring a watch; some testing rooms may not have clocks. Finally, be sure to bring along your test center admission ticket and a current photo I.D.

# At the Test Center—Some Tips

Arrive early enough to find the building and testing room. When you reach the location, wait in the assigned area until the proctor begins the test administration. He or she will instruct you in filling out the answer booklet (if taking written tests) or logging on to the computer (if taking computer-based tests).

Once testing has begun, keep track of time. Do not spend too long on any single question. Be sure to read each question carefully so that you understand exactly what is being asked. Do not mark answers in the test booklet; they must be marked on the answer booklet. Your test will not be scored if your answers are not on your answer booklet.

If a question is difficult, mark the answer that you think is correct and put a check by it in the test book. (Computer-based tests allow you to do this on screen.) Then go on to the next question. If you finish before time is up, you may go back to the questions that you checked.

It is to your advantage to answer every question. Do not leave any answers blank. Your score will be based only on the number of correct answers that you give.

# **Test Content and Sample Questions**

The following material is designed to help technicians prepare for the ASE certification tests.

Each section begins with the Test Specifications, which will list the main categories covered on that particular test and the number of test questions and percentage of the test devoted to each topic.

The Task List describes the work activities a technician should be able to perform in each technical area covered on that test. This list was developed by working technicians and technical experts from across the country and will provide a valuable check list of what to study for the test.

These task descriptions offer detailed information to technicians preparing for the test and to persons who may be instructing technicians. The task lists may also serve as guidelines for question writers, reviewers, and test assemblers.

It should also be noted that the number of questions in each content area may not equal the number of tasks listed. Some of the tasks are complex and broad in scope and may be covered by several questions. Other tasks are simple and narrow in scope and one question may cover several tasks. The main objective in listing the tasks is to describe accurately what is done on the job, not to make each task correspond to a particular test question.

Sample questions follow. Although these same questions will not appear on actual tests, they are in the same format as actual test questions. All five types of multiple-choice questions used on the ASE tests are represented here. Note the different instructions for some questions.

# TEST SPECIFICATIONS AND TASK LIST ENGINE REPAIR (TEST A1)

Content Area	Questions in Test	Percentage of Test
A. General Engine Diagnosis	15	30%
B. Cylinder Head and Valve Train		
Diagnosis and Repair	10	20%
C. Engine Block Diagnosis and Repair	10	20%
<ul> <li>D. Lubrication and Cooling Systems</li> <li>Diagnosis and Repair</li> </ul>	8	16%
E. Fuel, Electrical, Ignition, and Exhaust Systems Inspection and Service	7	14%
Total	50	100%

#### A. General Engine Diagnosis (15 questions)

- 1. Verify driver's complaint and/or road test vehicle; determine necessary action.
- 2. Determine if no-crank, cranks but will not start, or hard starting condition is an engine mechanical problem, or is caused by another vehicle subsystem.
- Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.
- 4. Isolate engine noises and vibrations; determine necessary action.
- 5. Diagnose the cause of excessive oil consumption, coolant consumption, unusual engine exhaust color, and odor; determine necessary action.
- 6. Perform engine vacuum tests; determine necessary action.
- 7. Perform cylinder power balance tests; determine necessary action.
- 8. Perform cylinder cranking compression tests; determine necessary action.
- 9. Perform cylinder leakage tests; determine necessary action.

#### B. Cylinder Head and Valve Train Diagnosis and Repair (10 questions)

- 1. Remove cylinder heads, disassemble, clean, and prepare for inspection.
- Visually inspect cylinder heads for cracks, warpage, corrosion, leakage, and the condition of passages; determine needed repairs.
- 3. Inspect and repair damaged threads where allowed; install core and gallery plugs.
- Inspect, test, and verify valve springs for squareness, pressure, and free height comparison; replace as necessary.
- 5. Inspect valve spring retainers, rotators, locks/keepers, and lock grooves.
- 6. Replace valve stem seals.
- Inspect valve guides for wear; check valve stem-to-guide clearance; determine needed repairs.

## A1 TASK LIST (CONTINUED)

- 8. Inspect valves and valve seats; determine needed repairs.
- Check valve spring installed (assembled) height and valve stem height; determined needed repairs.
- 10. Inspect pushrods, rocker arms, rocker arm pivots, and shafts for wear, bending, cracks, looseness, and blocked oil passages; repair or replace as required.
- 11. Inspect and replace hydraulic or mechanical lifters/lash adjusters.
- 12. Adjust valves on engines with mechanical or hydraulic lifters.
- 13. Inspect and replace camshaft(s) (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 variable valve timing components).
- 14. Inspect and measure camshaft journals and lobes; measure camshaft lift.
- Inspect and measure camshaft bore for wear, damage, out-of-round, and alignment; determine needed repairs.
- 16. Inspect valve timing; time camshaft(s) to crankshaft.
- 17. Inspect cylinder head mating surface condition and finish, reassemble and install gasket(s) and cylinder head(s); replace/torque bolts according to manufacturers' procedures.

#### C. Engine Block Diagnosis and Repair (10 questions)

- Remove and disassemble engine block; clean and prepare components for inspection and reassembly.
- Visually inspect engine block for cracks, corrosion, the condition of passages, core and gallery plug hole condition, surface warpage, and surface finish and condition; determine necessary action.
- 3. Inspect and repair damaged threads where allowed; install core and gallery plugs.
- 4. Inspect and measure cylinder walls; hone and clean cylinder walls; determine need for further action.
- 5. Inspect crankshaft for end play, journal damage, keyway damage, thrust flange and sealing surface condition, and visual surface cracks; check oil passage condition; measure journal wear; check crankshaft reluctor ring/tone wheel (where applicable); determine necessary action.
- Inspect and measure main bearing bores and cap alignment; mark caps for location and direction.
- Install main bearings and crankshaft; check bearing clearances and end play; replace/torque bolts according to manufacturers' procedures.
- 8. Inspect camshaft bearings for excessive wear and alignment; replace bearings if necessary; install camshaft, timing chain and gears; check end play.
- 9. Inspect auxiliary (balance, intermediate, idler, counterbalance, or silencer) shaft(s), drive(s)/gear(s), and support bearings for damage and wear; time balance shaft to crankshaft; determine necessary action.
- 10. Inspect, measure, service, or replace pistons and piston/wrist pins; identify piston and bearing wear patterns caused by connecting rod alignment problems; determine necessary action.
- Inspect connecting rods for damage, bore condition, and pin fit; determine necessary action.

## A1 TASK LIST (CONTINUED)

- 12. Inspect, measure, and install or replace piston rings; assemble piston and connecting rod; install piston/rod assembly; check bearing clearance and sideplay; install connecting rod bearings; replace/torque fasteners according to manufacturers' procedures.
- 13. Inspect, reinstall, or replace crankshaft vibration damper (harmonic balancer).
- 14. Inspect crankshaft flange and flywheel mating surfaces; inspect and replace crankshaft pilot bearing/bushing (if applicable); inspect flywheel/flexplate for cracks and wear (includes flywheel ring gear); measure flywheel runout; determine necessary action.
- 15. Inspect and replace pans and covers.
- 16. Assemble the engine using gaskets, seals, and formed-in-place (tube-applied) seal-ants, thread sealers, according to manufacturers' specifications; reinstall engine.

#### D. Lubrication and Cooling Systems Diagnosis and Repair (8 questions)

- 1. Diagnose engine lubrication system problems; perform oil pressure tests; determine necessary action.
- 2. Disassemble and inspect oil pump (includes gears, rotors, housing, and pick-up assembly); measure oil pump clearance; inspect pressure relief devices and pump drive; determine necessary action.
- 3. Inspect, test, and replace internal and external engine oil coolers.
- 4. Fill crankcase with oil and install engine oil filter.
- Perform cooling system pressure tests; perform coolant dye test; determine necessary action.
- Inspect and test radiator, heater core, pressure cap, and coolant recovery system; replace as required.
- 7. Inspect, replace, and adjust drive belt(s), tensioner(s), and pulleys.
- 8. Inspect and replace engine cooling system and heater system hoses, pipes and fittings.
- 9. Inspect, test, and replace thermostat, coolant by-pass, and thermostat housing.
- Inspect and test coolant; drain, flush, and refill cooling system with recommended coolant; bleed air as required.
- 11. Inspect and replace water pump.
- 12. Inspect and test fan (both electrical and mechanical), fan clutch, fan shroud, air dams, and cooling fan electrical circuits; repair or replace as required.
- 13. Verify proper operation of engine related warning indicators.

# E. Fuel, Electrical, Ignition, and Exhaust Systems Inspection and Service (7 questions)

- Inspect, clean or replace fuel injection system components, intake manifold, and gaskets.
- 2. Inspect, service or replace air filters, filter housings, and intake ductwork.
- 3. Inspect turbocharger/supercharger; determine necessary action.
- 4. Test engine cranking system; determine needed repairs.
- 5. Inspect and replace crankcase ventilation system components.
- 6. Inspect and install ignition system components; adjust timing.
- 7. Inspect and diagnose exhaust system; determine needed repairs.

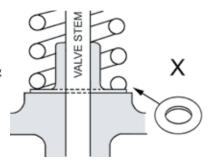
# Sample Questions Engine Repair (Test A1)

#### **Ouestions:**

 Technician A says that part X shown is used to rotate the valve spring.
 Technician B says that part X shown above is used to correct installed spring height.

Who is right?

- (A) A only
- \* (B) B only
  - (C) Both A and B
  - (D) Neither A nor B



- 2. A compression test shows that one cylinder is too low. A leakage test on that cylinder shows that there is too much leakage. During the test, air could be heard coming from the tail pipe. Which of these could be the cause?
  - (A) Broken piston rings
  - (B) A bad head gasket
  - (C) A bad exhaust gasket
  - \* (D) An exhaust valve not seating
- 3. Technician A says that main bearing oil clearance can be checked with plastigage.

Technician B says that main bearing oil clearance can be checked with a feeler gauge.

Who is right?

- \* (A) A only
  - (B) B only

- (C) Both A and B
- (D) Neither A nor B
- 4. An engine is using too much oil.

Technician A says that worn valve guides could be the cause.

Technician B says that tapered cylinder walls could be the cause.

Who is right?

- (A) A only
- (B) B only

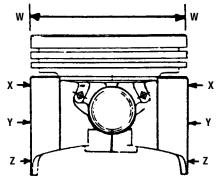
- \* (C) Both A and B
- (D) Neither A nor B

# A1 SAMPLE QUESTIONS (CONTINUED)

5. A compression test has been made on an in-line 4-cylinder engine. Cylinders 2 and 3 have readings of 10 psi. Cylinder 1 has a reading of 140 psi and cylinder 4 has a reading of 145 psi.

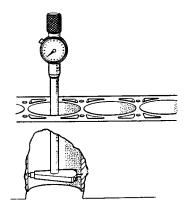
Technician A says that these readings could be caused by a blown head gasket. Technician B says that these readings could be caused by wrong valve timing. Who is right?

- \* (A) A only
  - (B) B only
  - (C) Both A and B
  - (D) Neither A nor B



- 6. To determine piston-to-cylinder wall clearance, the diameter of the piston shown above should be measured at:
  - (A) W.
  - (B) X.
  - \* (C) Y.
    - (D) Z.
- 7. Which of these would most likely cause a fuel-injected engine to have low fuel pressure?
  - \* (A) A clogged fuel filter
    - (B) A clogged fuel injector
    - (C) A restricted fuel return line
    - (D) A stuck-closed fuel pressure regulator

# A1 SAMPLE QUESTIONS (CONTINUED)



8. Technician A says that the setup shown above can be used to check cylinder taper.

Technician B says that the setup can be used to check cylinder out-of-round. Who is right?

(A) A only

\* (C) Both A and B

(B) B only

- (D) Neither A nor B
- The pressure and volume tests on a mechanical fuel pump are both below specs.

Technician A says that an air leak in the fuel line between the tank and pump could be the cause.

Technician B says that a plugged fuel tank pick up filter could be the cause.

Who is right?

(A) A only (B) B only

\* (C) Both A and B
(D) Neither A nor B

#### Question 10 is not like the ones above.

It has the word **LEAST**. For this question, look for the choice that would **LEAST LIKELY** cause the described situation. Read the entire question carefully before choosing your answer.

- 10. The LEAST likely cause of a bent push rod is:
  - (A) excessive engine rpm.
  - (B) a sticking valve.
  - \* (C) excessive valve guide clearance.
    - (D) a worn rocker arm stud.

# TEST SPECIFICATIONS AND TASK LIST AUTOMATIC TRANSMISSION/TRANSAXLE (TEST A2)

Content Area	Questions in Test	Percentage of Test	
<ul><li>A. General Transmission/Transaxle Diagr</li><li>1. Mechanical/Hydraulic Systems (11)</li><li>2. Electronic Systems (14)</li></ul>	nosis 25	50%	
B. In-Vehicle Transmission/Transaxle     Maintenance and Repair	12	24%	
<ul> <li>C. Off-Vehicle Transmission/Transaxle Re</li> <li>1. Removal and Installation (4)</li> <li>2. Disassembly and Assembly (5)</li> <li>3. Friction and Reaction Units (4)</li> </ul>	epair 13	26%	
Total	50	100%	

#### A. General Transmission/Transaxle Diagnosis (25 questions)

#### 1. Mechanical/Hydraulic Systems (11 questions)

- Road test the vehicle to verify mechanical/hydraulic system problems based on driver's concern; determine necessary action.
- Diagnose noise, vibration, harshness, and shift quality problems; determine necessary action.
- 3. Diagnose fluid usage, type, level, and condition problems; determine necessary action.
- 4. Perform pressure tests; determine necessary action.
- 5. Perform stall tests; determine necessary action.
- 6. Perform torque converter clutch (lock-up converter) mechanical/hydraulic system tests; determine necessary action.

#### 2. Electronic Systems (14 questions)

- Road test the vehicle to verify electronic system problems based on driver's concern; determine necessary action.
- Perform pressure tests on transmissions equipped with electronic pressure control; determine necessary action.
- Perform torque converter clutch (lock-up converter) electronic system tests; determine necessary action.

## **A2 TASK LIST (CONTINUED)**

- Diagnose electronic transmission control systems using appropriate test equipment and service information (such as: shop manuals, technical service bulletins, schematics, etc.); determine necessary action.
- Verify proper operation of charging system; check battery, connections, vehicle power, and grounds.
- 6. Differentiate between engine performance, or other vehicle systems, and transmission/transaxle related problems; determine necessary action.
- 7. Diagnose shift quality concerns resulting from problems in the electronic transmission control system; determine necessary action.

#### B. In-Vehicle Transmission/Transaxle Maintenance and Repair (12 questions)

- 1. Inspect, adjust, and replace manual valve shift linkage, transmission range sensor/switch, and park/neutral position switch (inhibitor/neutral safety switch).
- Inspect, adjust, and replace cables or linkages for throttle valve (TV), kickdown, and accelerator pedal.
- 3. Inspect and replace external seals and gaskets.
- 4. Inspect and replace driveshaft yoke, drive axle joints, bushings, and seals.
- 5. Check condition of engine cooling system; inspect transmission lines and fittings.
- Inspect valve body mating surfaces, bores, valves, springs, sleeves, retainers, brackets, check balls, screens, spacers, and gaskets; replace as necessary.
- 7. Check and adjust valve body bolt torque.
- 8. Inspect accumulator and servo bores, pistons, seals, pins/pin bores, springs, and retainers; repair or replace as necessary; adjust bands.
- Inspect, test, adjust, repair, or replace electrical/electronic components and circuits including computers, solenoids, sensors, relays, terminals, connectors, switches, and harnesses.
- 10. Inspect, replace, and align power train mounts.
- 11. Replace fluid and filter(s); verify proper fluid level and type.

#### C. Off-Vehicle Transmission/Transaxle Repair (13 questions)

#### 1. Removal and Installation (4 questions)

- 1. Remove and replace transmission/transaxle; inspect engine core plugs, rear crankshaft seal, transmission dowel pins, dowel pin holes, and mating surfaces.
- 2. Inspect converter flex (drive) plate, converter attaching bolts, converter pilot, converter pump drive surfaces, converter end play, and crankshaft pilot bore.
- 3. Inspect, test, flush or replace transmission oil cooler.

#### 2. Disassembly and Assembly (5 questions)

- Disassemble, clean, and inspect transmission case, sub-assemblies, mating surfaces, and thread condition.
- 2. Inspect, measure, and replace oil pump components.
- 3. Check bearing preload; determine needed service.
- 4. Check end play; inspect, measure, and replace thrust washers and bearings as needed.
- 5. Inspect and replace shafts.
- 6. Inspect oil delivery circuit, including seal rings, ring grooves, sealing surface areas, feed pipes, orifices, and encapsulated check valves (balls).
- 7. Inspect and replace bushings.
- 8. Inspect and measure planetary gear assembly; replace parts as necessary.

## **A2 TASK LIST (CONTINUED)**

- Inspect case bores, passages, bushings, vents, mating surfaces, thread condition, and dowel pins; repair or replace as necessary.
- 10. Inspect and replace transaxle drive chains, sprockets, gears, bearings, and bushings.
- 11. Inspect, measure, repair, adjust or replace transaxle final drive components.
- 12. Assemble after repair.

### 3. Friction and Reaction Units (4 questions)

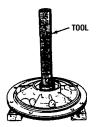
- 1. Inspect hydraulic clutch pack assembly; replace parts as necessary.
- 2. Measure and adjust clutch pack clearance.
- 3. Air test the operation of clutch and servo assemblies.
- 4. Inspect one-way clutch assemblies; replace parts as necessary.
- 5. Inspect bands and drums (housings/cylinders); replace and/or adjust as necessary.

# Sample Questions Automatic Transmission/Transaxle (Test A2)

# QUESTIONS:

1.	An automatic transmission does not hold Technician A says that misadjusted shift I Technician B says that a roller clutch inst Who is right?	inkage could be the cause.
	* (A) A only	(C) Both A and B
	(B) B only	(D) Neither A nor B
2.	A vehicle with an automatic transaxle, an accelerates poorly from a stop. Accelerate Which of these could be the cause?	
	(A) A worn front pump	(C) A worn planetary gear set
	* (B) A failed torque converter	(D) A low fluid level
3.	The transmission slips when cold. Which (A) A shorted low/reverse pressure swit (B) Line pressure is at maximum in 1st (C) A disconnected line pressure sensor * (D) Low line pressure	ch gear
4.	The automatic transaxle upshifts harshly The most likely cause is a failed:	during normal acceleration.
	(A) oxygen sensor.	* (C) throttle position sensor.
	(B) idle air control valve.	(D) intake air temperature sensor
5.	With the transmission pan removed, the bleak is to:  (A) check the filter pick-up tube seal.  (B) check the line pressure.  (C) remove and check the valve body.  * (D) perform an air pressure test.	est way to pin-point an oil pressure

## **A2 SAMPLE QUESTIONS (CONTINUED)**



- 6. The tool in the setup shown above is being used to remove the:
  - \* (A) pump bushing.

(C) stator support.

(B) pump seal.

- (D) stator seal.
- 7. A vehicle with an OBD II computer system has stored transmission trouble codes. After repairs are completed, the trouble codes should be cleared by:
  - (A) disconnecting the battery.
  - (B) test driving the vehicle.
  - \* (C) using a scan tool.
    - (D) removing the PCM fuse.

#### Question 8 is not like the ones above.

It has the word **EXCEPT**. For this question, look for the choice that could **NOT** cause the described situation. Read the entire question carefully before choosing your answer.

- 8. Too much automatic transmission shaft end play could be caused by any of these EXCEPT a worn:
  - \* (A) clutch.
    - (B) selective washer.
    - (C) transmission case.
    - (D) planetary carrier.

# Test Specifications and Task List Manual Drive Train and Axles (Test A3)

Content Area	Questions in Test	Percentage of Test	
A. Clutch Diagnosis and Repair	6	16%	
B. Transmission Diagnosis and Repair	7	17%	
C. Transaxle Diagnosis and Repair	7	17%	
<ul> <li>D. Drive Shaft/Half Shaft and Universal Joint/Constant Velocity (CV) Joint Diagnosis and Repair (Front and Rear Wheel Drive)</li> </ul>	5	13%	
<ul> <li>E. Rear Axle Diagnosis and Repair</li> <li>1. Ring and Pinion Gears (3)</li> <li>2. Differential Case/Carrier Assembly (2</li> <li>3. Limited Slip/Locking Differential (1)</li> <li>4. Axle Shafts and Housing(1)</li> </ul>	7	17%	
F. Four-Wheel Drive/All-Wheel Drive Component Diagnosis and Repair	8	20%	
Total	40	100%	

#### A. Clutch Diagnosis and Repair (6 questions)

- 1. Diagnose clutch noise, binding, slippage, pulsation, chatter, pedal feel/effort, and release problems; determine needed repairs.
- 2. Inspect, adjust, and replace clutch pedal linkage, cables and automatic adjuster mechanisms, brackets, bushings, pivots, springs, and electrical switches.
- 3. Inspect, adjust, replace, and bleed hydraulic clutch slave/release cylinder, master cylinder, lines, and hoses; clean and flush hydraulic system; refill with proper fluid.
- 4. Inspect, adjust, and replace release (throw-out) bearing, bearing retainer, lever, and pivot.
- Inspect and replace clutch disc and pressure plate assembly; inspect input shaft pilot and splines.
- 6. Inspect pilot bearing/bushing inner and outer bores; inspect and replace pilot bearing/bushing.
- 7. Inspect and measure flywheel and ring gear; inspect dual-mass flywheel where required; repair or replace as necessary.
- 8. Inspect engine block, clutch (bell) housing, transmission case mating surfaces, and alignment dowels; inspect engine core plugs, rear main engine seal, and other sources of fluid contamination; determine needed repairs.
- 9. Measure flywheel surface runout and crankshaft end play; determine needed repairs.
- 10. Inspect, replace, and align powertrain mounts.

# A3 TASK LIST (CONTINUED)

#### **B. Transmission Diagnosis and Repair (7 questions)**

- 1. Diagnose transmission noise, difficult shifting, gear clash, jumping out of gear, fluid condition and type, and fluid leakage problems; determine needed repairs.
- 2. Inspect, adjust, and replace transmission external shifter assembly, shift linkages, brackets, bushings/grommets, pivots, and levers.
- 3. Inspect and replace transmission gaskets, sealants, seals, and fasteners; inspect sealing surfaces.
- 4. Remove and replace transmission; inspect transmission mounts.
- 5. Disassemble and clean transmission components; reassemble transmission.
- Inspect, repair, and/or replace transmission shift cover and internal shift forks, bushings, bearings, levers, shafts, sleeves, detent mechanisms, interlocks, and springs.
- 7. Inspect and replace input (clutch) shaft, bearings, and retainers.
- 8. Inspect and replace mainshaft, gears, thrust washers, bearings, and retainers/snap rings; measure clearance and end play.
- 9. Inspect and replace synchronizer hub, sleeve, keys (inserts), springs, and blocking (synchronizing) rings/mechanisms; measure blocking ring clearance.
- Inspect and replace countershaft, counter (cluster) gear, bearings, thrust washers, and retainers/snap rings.
- 11. Inspect and replace reverse idler gear, shaft, bearings, thrust washers, and retainers/snap rings.
- 12. Measure and adjust bearing preload or end play (shim/spacer selection procedure).
- 13. Inspect, repair, and replace extension housing and transmission case mating surfaces, bores, dowels, bushings, and vents.
- 14. Inspect and replace transmission components related to speedometer operation.
- 15. Inspect, test, and replace transmission sensors, actuators, and switches.
- 16. Inspect lubrication systems.
- 17. Check fluid level; refill with proper fluid.

### C. Transaxle Diagnosis and Repair (7 questions)

- 1. Diagnose transaxle noise, difficult shifting, gear clash, jumping out of gear, fluid condition and type, and fluid leakage problems; determine needed repairs.
- 2. Inspect, adjust, lubricate and replace transaxle external shift assemblies, linkages, brackets, bushings/grommets, cables, pivots, and levers.
- Inspect and replace transaxle gaskets, sealants, seals, and fasteners; inspect sealing surfaces.
- Remove and replace transaxle; inspect, replace, and align transaxle mounts and subframe/cradle assembly.
- 5. Disassemble and clean transaxle components; reassemble transaxle.
- Inspect, repair, and/or replace transaxle shift cover and internal shift forks, levers, bushings, shafts, sleeves, detent mechanisms, interlocks, and springs.
- 7. Inspect and replace input shaft and output shaft, gears, thrust washers, bearings, and retainers/snap rings.
- 8. Inspect and replace synchronizer hub, sleeve, keys (inserts), springs, and blocking (synchronizing) rings; measure blocking ring clearance.
- Inspect and replace reverse idler gear, shaft, bearings, thrust washers, and retainers/ snap rings.

## A3 TASK LIST (CONTINUED)

- Inspect, repair, and/or replace transaxle case mating surfaces, bores, dowels, bushings, bearings, and vents.
- 11. Inspect and replace transaxle components related to speedometer operation.
- 12. Inspect, test, and replace transaxle sensors, actuators, and switches.
- 13. Diagnose differential assembly noise and wear; determine needed repairs.
- 14. Remove and replace differential final drive assembly.
- 15. Inspect, measure, adjust and replace differential pinion (spider) gears, shaft, side gears, thrust washers, side bearings, and case/carrier.
- Diagnose limited slip differential noise, slippage, and chatter problems; determine needed repairs.
- Measure and adjust shaft and differential bearing preload and end play (shim/spacer selection procedure).
- 18. Inspect lubrication systems.
- 19. Check fluid level; refill with proper fluid.

# D. Drive Shaft/Half-Shaft and Universal Joint/Constant Velocity (CV) Joint Diagnosis and Repair (Front and Rear Wheel Drive) (5 questions)

- Diagnose shaft and universal/CV joint noise and vibration problems; determine needed repairs.
- 2. Inspect, service, and replace shafts, yokes, boots, and universal/CV joints; verify proper phasing.
- 3. Inspect, service, and replace shaft center support bearings.
- 4. Check and correct drive/propeller shaft balance.
- 5. Measure drive shaft runout.
- 6. Measure and adjust drive shaft working angles.
- 7. Inspect, service, and replace wheel bearings, seals, and hubs.

# E. Rear Wheel Drive Axle Diagnosis and Repair (7 questions)

### 1. Ring and Pinion Gears (3 questions)

- 1. Diagnose noise, vibration, and fluid leakage problems; determine needed repairs.
- Inspect and replace companion flange, yoke, and pinion seal; measure companion flange runout.
- 3. Measure ring gear runout; determine needed repairs.
- Inspect and replace ring and pinion gear set, collapsible spacers, sleeves (shims), and bearings.
- 5. Measure and adjust drive pinion depth.
- 6. Measure and adjust drive pinion bearing preload (collapsible spacer or shim type).
- 7. Measure and adjust differential (side) bearing preload, and ring and pinion backlash (threaded adjuster or shim type).
- 8. Perform ring and pinion tooth contact pattern checks; determine needed adjustments.

# 2. Differential Case/Carrier Assembly (2 questions)

- Diagnose differential assembly noise and vibration problems; determine needed repairs.
- 2. Remove and replace differential assembly.
- 3. Inspect, measure, adjust and replace differential pinion (spider) gears, shaft, side gears, thrust washers, side bearings, and case/carrier.
- 4. Measure differential case/carrier runout; determine needed repairs.

# A3 TASK LIST (CONTINUED)

#### 3. Limited Slip/Locking Differential (1 question)

- Diagnose limited slip differential noise, slippage, and chatter problems; determine needed repairs.
- 2. Inspect, drain, and refill with proper lubricant.
- 3. Inspect, adjust, repair or replace limited slip or locking assembly components.

#### 4. Axle Shafts and Housing (1 question)

- Diagnose rear axle shaft noise, vibration, and fluid leakage problems; determine needed repairs.
- 2. Inspect and replace rear axle shaft wheel studs.
- Remove, inspect, adjust, and/or replace rear axle shafts, splines, seals, bearings, and retainers.
- 4. Measure rear axle flange runout and shaft end play; determine needed repairs.
- 5. Inspect axle housing and vent.

#### F. Four-Wheel Drive/All-Wheel Drive Component Diagnosis and Repair (8 questions)

- 1. Diagnose drive assembly noise, vibration, shifting, leakage and steering problems; determine needed repairs.
- 2. Inspect, adjust, and repair transfer case manual shifting mechanisms, bushings, mounts, levers, and brackets.
- 3. Remove and replace transfer case.
- 4. Disassemble transfer case; clean and inspect internal transfer case components; determine needed repairs.
- Reassemble transfer case.
- 6. Check transfer case fluid level; drain and refill with proper fluid.
- 7. Inspect, service, and replace drive/propeller shaft and universal/CV joints.
- 8. Inspect, service, and replace drive axle universal/CV joints and drive/half shafts.
- 9. Inspect, service, and replace wheel bearings, seals, and hubs.
- Check transfer case and axle seals and all vents.
- 11. Test, diagnose, and replace actuation and engagement systems (including: viscous, hydraulic, magnetic, mechanical, vacuum, and electrical/electronic).
- 12. Inspect tires for proper size and condition for vehicle application.

# Sample Questions Manual Drive Train and Axles (Test A3)

#### QUESTIONS:

- 1. A manual transmission slips out of high gear. Which of these could be the cause?
  - (A) Worn blocking rings
  - \* (B) Too much main shaft end play
    - (C) Broken synchronizer keys
    - (D) Worn shifter interlocks
- 2. In a vehicle with a single-plate clutch, loss of free pedal can be caused by a:
  - (A) worn release bearing.
  - (B) broken clutch linkage.
  - \* (C) worn clutch disc facing.
    - (D) weak pressure plate springs.
- A four-speed fully synchronized transmission has a clunking or knocking noise in first and reverse only.

Technician A says that a broken tooth on the clutch (input) gear could be the cause.

Technician B says that a broken tooth on the counter (cluster) gear could be the cause.

Who is right?

- (A) A only
- \* (B) B only
  - (C) Both A and B
  - (D) Neither A nor B
- A manual transaxle makes a clunking noise on acceleration and on deceleration.

Technician A says that a loose differential case pinion shaft could be the cause. Technician B says that worn CV joints could be the cause.

Who is right?

- (A) A only
- (B) B only
- \* (C) Both A and B
  - (D) Neither A nor B

## A3 SAMPLE QUESTIONS (CONTINUED)

Technician A says that the set-up shown can be used to check pinionto-ring gear preload.

Technician B says that the set-up can be used to check pinion flange nut torque.

Who is right?

- (A) A only
- (B) B only
- (C) Both A and B
- \* (D) Neither A nor B
- 6. Which of these is the technician measuring in the illustration shown to the right?
  - \* (A) Side gear clearance
    - (B) Ring gear runout
    - (C) Pinion depth
    - (D) Bearing preload
- 7. A four-wheel drive vehicle vibrates while the front axle is engaged.

Technician A says that a bad front axle shaft CV joint could be the cause.

Technician B says that different front and rear tire diameters could be the cause.

Who is right?

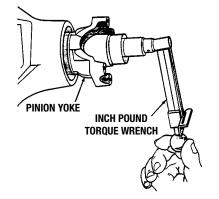
- (A) A only
- (B) B only

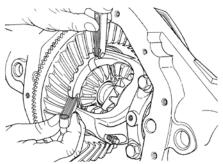
- \* (C) Both A and B
  - (D) Neither A nor B

## Question 8 is not like the ones above.

It has the word **EXCEPT**. For this question, look for the choice that could **NOT** cause the described situation. Read the entire question carefully before choosing your answer.

- 8. The clutch does not release fully when the pedal is pushed to the floor. Any of these could be the cause EXCEPT:
  - \* (A) weak pressure plate springs.
    - (B) too much free pedal travel.
    - (C) a warped clutch disc.
    - (D) a seized pilot bearing.





# Test Specifications and Task List Suspension and Steering (Test A4)

Content Area	Questions in Test	Percentage of Test
<ul> <li>A. Steering Systems Diagnosis and Repair</li> <li>1. Steering Columns (3)</li> <li>2. Steering Units (4)</li> <li>3. Steering Linkage (3)</li> </ul>	10	25%
<ul><li>B. Suspension Systems Diagnosis and Re</li><li>1. Front Suspensions (6)</li><li>2. Rear Suspensions (5)</li></ul>	pair 11	28%
C. Related Suspension and Steering Service	ce 2	5%
<ul><li>D. Wheel Alignment Diagnosis, Adjustment, and Repair</li></ul>	12	30%
E. Wheel and Tire Diagnosis and Service	5	13%
Total	40	100%

#### A. Steering Systems Diagnosis and Repair (10 questions)

#### 1. Steering Columns (3 questions)

- 1. Diagnose steering column noises and steering effort concerns (including manual and electronic tilt and telescoping mechanisms); determine needed repairs.
- Inspect and replace steering column, steering shaft U-joint(s), flexible coupling(s), collapsible columns, steering wheels (includes steering wheels and columns equipped with air bags and/or other steering wheel/column mounted controls, sensors, and components).
- Disarm, enable, and properly handle airbag system components during vehicle service following manufacturers' procedures.

### 2. Steering Units (4 questions)

- Diagnose steering gear (non-rack and pinion type) noises, binding, vibration, freeplay, steering effort, steering pull (lead), and leakage concerns; determine needed repairs.
- Diagnose rack and pinion steering gear noises, binding, vibration, freeplay, steering effort, steering pull (lead), and leakage concerns; determine needed repairs.
- 3. Inspect power steering fluid level and condition; determine fluid type and adjust fluid level in accordance with vehicle manufacturers' recommendations.

# A4 TASK LIST (CONTINUED)

- 4. Inspect, adjust, align, and replace power steering pump belt(s), tensioners and pulleys.
- Diagnose power steering pump noises, vibration, and fluid leakage; determine needed repairs.
- Remove and replace power steering pump; inspect pump mounting and attaching brackets; remove and replace power steering pump pulley; transfer related components
- 7. Perform power steering system pressure and flow tests; determine needed repairs.
- 8. Inspect and replace power steering hoses, fittings, O-rings, coolers, and filters.
- 9. Remove and replace steering gear (non-rack and pinion type).
- Remove and replace rack and pinion steering gear; inspect and replace mounting bushings and brackets.
- Adjust steering gear (non-rack and pinion type) worm bearing preload and sector lash.
- 12. Inspect and replace steering gear (non-rack and pinion type) seals and gaskets.
- 13. Adjust rack and pinion steering gear.
- 14. Inspect and replace rack and pinion steering gear bellows/boots.
- 15. Flush, fill, and bleed power steering system.
- 16. Diagnose, inspect, repair or replace components of variable-assist steering systems.

#### 3. Steering Linkage (3 questions)

- Inspect and adjust (where applicable) front and rear steering linkage geometry (including parallelism and vehicle ride height).
- 2. Inspect and replace pitman arm.
- 3. Inspect and replace center link (relay rod/drag link/intermediate rod).
- 4. Inspect, adjust (where applicable), and replace idler arm(s) and mountings.
- Inspect, replace, and adjust tie rods, tie rod sleeves/adjusters, clamps, and tie rod ends (sockets/bushings).
- 6. Inspect and replace steering linkage damper(s).

## **B. Suspension Systems Diagnosis and Repair (13 questions)**

#### 1. Front Suspensions (6 questions)

- 1. Diagnose front suspension system noises, handling, ride height and ride quality concerns; determine needed repairs.
- 2. Inspect and replace upper and lower control arms, bushings and shafts.
- 3. Inspect and replace rebound and jounce bumpers.
- Inspect, adjust, and replace track bar, strut rods/radius arms and related mounts/bushings.
- 5. Inspect and replace upper and lower ball joints (with or without wear indicators).
- 6. Inspect non-independent front axle assembly for damage and misalignment.
- 7. Inspect and replace front steering knuckle/spindle assemblies and steering arms.
- 8. Inspect and replace front suspension system coil springs and spring insulators (silencers).
- 9. Inspect and replace front suspension system leaf spring(s), leaf spring insulators (silencers), shackles, brackets, bushings, center pins/bolts and mounts.
- 10. Inspect, replace, and adjust front suspension system torsion bars and mounts.

### **A4 TASK LIST (CONTINUED)**

- 11. Inspect and replace front stabilizer bar (sway bar) bushings, brackets, and links.
- 12. Inspect and replace front strut cartridge or assembly.
- 13. Inspect and replace front strut bearing and mount.

#### 2. Rear Suspensions (5 questions)

- Diagnose rear suspension system noises, handling, ride height and ride quality concerns; determine needed repairs.
- Inspect and replace rear suspension system coil springs and spring insulators (silencers).
- 3. Inspect and replace rear suspension system lateral links/arms (track bars), control (trailing) arms, stabilizer bars (sway bars), bushings, and mounts.
- 4. Inspect and replace rear suspension system leaf spring(s), leaf spring insulators (silencers), shackles, brackets, bushings, center pins/bolts and mounts.
- 5. Inspect and replace rear rebound and jounce bumpers.
- 6. Inspect and replace rear strut cartridge or assembly, and upper mount assembly.
- 7. Inspect non-independent rear axle assembly for damage and misalignment.
- 8. Inspect and replace rear ball joints and tie rod/toe link assemblies.
- 9. Inspect and replace rear knuckle/spindle assembly.

#### C. Related Suspension and Steering Service (2 questions)

- 1. Inspect and replace shock absorbers, mounts, and bushings.
- 2. Diagnose and service front and/or rear wheel bearings/hub assemblies.
- 3. Diagnose, inspect, adjust, repair or replace components (including sensors, switches, actuators, and control units) of electronically controlled suspension systems (including primary and supplemental air suspension and ride control systems).
- 4. Inspect and repair front and/or rear cradle (crossmember/subframe) mountings, bushings, brackets, and bolts.
- 5. Diagnose, inspect, adjust, repair or replace components (including sensors, switches, actuators, and control units) of electronically controlled hydraulic, and electrically assisted steering systems; initialize system as required.
- 6. Diagnose, inspect, repair or replace components of power steering idle speed compensation systems.

#### D. Wheel Alignment Diagnosis, Adjustment, and Repair (12 questions)

- 1. Diagnose vehicle wander, drift, pull, hard steering, bump steer (toe curve), memory steer, torque steer, and steering return concerns; determine needed repairs.
- 2. Measure vehicle ride height; determine needed repairs.
- 3. Measure front and rear wheel camber; determine needed repairs.
- 4. Adjust front and/or rear wheel camber on suspension systems with a camber adjustment.
- 5. Measure caster; determine needed repairs.
- 6. Adjust caster on suspension systems with a caster adjustment.
- 7. Measure and adjust front wheel toe.
- 8. Center the steering wheel.
- 9. Measure toe-out-on-turns (turning radius/angle); determine needed repairs.
- Measure SAI/KPI (steering axis inclination/king pin inclination); determine needed repairs.
- 11. Measure included angle; determine needed repairs.

## **A4 TASK LIST (CONTINUED)**

- 12. Measure rear wheel toe; determine needed repairs or adjustments.
- 13. Measure thrust angle; determine needed repairs or adjustments.
- 14. Measure front wheelbase setback/offset; determine needed repairs or adjustments.
- 15. Check front and/or rear cradle (crossmember/subframe) alignment; determine needed repairs or adjustments.

#### E. Wheel and Tire Diagnosis and Service (5 questions)

- 1. Diagnose tire wear patterns; determine needed repairs.
- 2. Inspect tire condition, size, and application (load and speed ratings).
- 3. Measure and adjust tire air pressure.
- Diagnose wheel/tire vibration, shimmy, and noise concerns; determine needed repairs.
- Rotate tires/wheels and torque fasteners according to manufacturers' recommendations.
- Measure wheel, tire, axle flange, and hub runout (radial and lateral); determine needed repairs.
- 7. Diagnose tire pull (lead) problems; determine corrective actions.
- 8. Dismount and mount tire on wheel.
- 9. Balance wheel and tire assembly.
- Test and diagnose tire pressure monitoring systems (direct and indirect); determine needed repairs. ■

# Sample Questions Suspension and Steering (Test A4)

#### **Q**UESTIONS:

1. 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
- 2. A vehicle wanders while being driven on level roads.

Technician A says that too much negative camber could be the cause.

Technician B says that too much positive caster could be the cause.

- Who is right?
  - (A) A only

(C) Both A and B

(B) B only

\* (D) Neither A nor B

#### READINGS

#### SPECS

	Left	Right	Left or Right
Camber	+ 3/4° or + 45 min.	- 1 1/2° or - 1° 30 min.	0 to + 1/2° or 0 to + 30 min.
Caster	0°	0°	0° to + 1°
Toe-in	1/16" or .16mm		1/16" to 3/16" or .16mm to .48mm

- 3. The alignment settings shown above would result in which of these conditions?
  - (A) Left tire wear on inside; vehicle does not pull to either side
  - \* (B) Right tire wear on inside; vehicle pulls to left
    - (C) Right tire wear on outside; vehicle pulls to left
    - (D) Right tire wear on outside; left tire wear on inside; vehicle pulls to left

## **A4 SAMPLE QUESTIONS (CONTINUED)**

4. A vehicle with rack and pinion steering has a shimmy.
Technician A says that worn rack-to-frame mounting bushings could be the cause.
Technician B says that loose inner or outer tie rod ends (sockets) could be the cause.
Who is right?

(A) A only

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

- 5. During a wheel alignment, a technician finds the toe-out-on-turns (turning radius) to be incorrect. Which of these could be the cause?
  - (A) Bent pitman arm
  - (B) Bent tie rod
  - (C) Bent idler arm
  - \* (D) Bent steering arm
- A vehicle pulls to the right during braking.
   Technician A says that a worn strut rod bushing could be the cause.

Technician B says that a bent right wheel could be the cause.

Technician B says that a bent right wheel could

Who is right?

\* (A) A only

(C) Both A and B

(B) B only

- (D) Neither A nor B
- 7. Which of these should the technician do first when aligning a light truck equipped with a torsion bar front suspension?
  - (A) Adjust the thrust angle
  - (B) Adjust the caster/camber
  - (C) Check/adjust the toe
  - \* (D) Check/adjust the ride height (curb height).
- 8. A pressure test is being performed on a vehicle with power steering. The pressure readings taken when the wheels are at the right and left stops are below specs. The readings are normal when the tester shutoff valve is closed.

Technician A says that these readings could be caused by a bad steering gear. Technician B says that these readings could be caused by a bad pump.

Who is right?

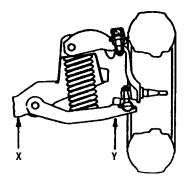
\* (A) A only

(C) Both A and B

(B) B only

(D) Neither A nor B

# **A4 SAMPLE QUESTIONS (CONTINUED)**



9. The suspension shown above is being checked for ball joint wear. Technician A says that the check can be made with the front end jacked up at "X."

Technician B says that the check can be made with the front end jacked up at "Y."

Who is right?

- (A) A only
- \* (B) B only
  - (C) Both A and B
  - (D) Neither A nor B

#### Question 10 is not like the ones above.

It has the word **EXCEPT**. For this question, look for the choice that could **NOT** cause the described situation. Read the entire question carefully before choosing your answer.

- 10. All of these could cause tire wear if not within manufacturer's specs EXCEPT:
  - \* (A) caster.
    - (B) wheel balance.
    - (C) toe-in.
    - (D) camber.

# Test Specifications and Task List Brakes (Test A5)

Content Area	Questions in Test	Percentage of Test
A. Hydraulic System Diagnosis and Repai	r 12	27%
1. Master Cylinder (3)		
2. Lines and Hoses (3)		
<ul><li>3. Valves and Switches (3)</li><li>4. Bleeding, Flushing, and Leak Testing</li></ul>	<b>J</b> (3)	
B. Drum Brake Diagnosis and Repair	5	11%
C. Disc Brake Diagnosis and Repair	10	22%
D. Power Assist Units Diagnosis and Repa	air 4	9%
Miscellaneous Systems Diagnosis and Repair	7	16%
<ul> <li>F. Electronic Brake Control Systems—And Brake Systems (ABS), Traction Control Systems TCS), and Electronic Stability</li> </ul>		
System (ESC)—Diagnosis and Repair	7	16%
Total	45	100%

# A. Hydraulic System Diagnosis and Repair (12 questions)

## 1. Master Cylinder (3 questions)

- 1. Diagnose poor stopping, dragging, high or low pedal, hard or spongy pedal caused by the master cylinder; determine needed repairs.
- Diagnose problems in the stepbore/quick take-up master cylinder and internal valves (e.g. volume control devices, quick take-up valve, fast-fill valve, pressure regulating valve); determine needed repairs.
- 3. Measure and adjust master cylinder pushrod length.
- Check master cylinder for failures by depressing brake pedal; determine needed repairs.
- 5. Diagnose the cause of master cylinder external fluid leakage.
- 6. Remove and replace master cylinder; bench bleed and test operation and install master cylinder; verify master cylinder function.

#### 2. Lines and Hoses (3 questions)

- Diagnose poor stopping, pulling, or dragging caused by problems in the lines and hoses; determine needed repairs.
- Inspect brake lines and fittings for leaks, dents, kinks, rust, cracks, or wear; inspect for loose fittings and supports; determine needed repairs.

#### **A5 TASK LIST (CONTINUED)**

- 3. Inspect flexible brake hoses for leaks, kinks, cracks, bulging, wear, or corrosion; inspect for loose fittings and supports; determine needed repairs.
- 4. Replace brake lines, hoses, fittings, and supports; fabricate brake lines using proper material and flaring procedures (double flare and ISO types).
- 5. Inspect brake lines and hoses for proper routing and support.

#### 3. Valves and Switches (3 questions)

- Diagnose poor stopping, pulling, or dragging caused by problems in the hydraulic system valve(s); determine needed repairs.
- Inspect, test, and replace metering, proportioning, pressure differential, and combination valves.
- 3. Inspect, test, replace, and adjust load or height sensing-type proportioning valve(s).
- 4. Inspect, test, and replace brake warning light, switch, sensor and circuit.

#### 4. Bleeding, Flushing, and Leak Testing (3 questions)

- 1. Diagnose poor stopping, pulling, dragging, or incorrect pedal travel caused by problems in the brake fluid; determined needed repairs.
- Bleed and/or flush hydraulic system using manual, pressure, vacuum, or surge gravity method(s).
- 3. Pressure test brake hydraulic system.
- 4. Select, handle, store, and install proper brake fluids (including silicone fluids).

#### B. Drum Brake Diagnosis and Repair (5 questions)

- 1. Diagnose poor stopping, pulling, dragging, or incorrect pedal travel caused by drum brake hydraulic problems; determine needed repairs.
- Diagnose poor stopping, noise, pulling, grabbing, dragging, pedal pulsation, or incorrect pedal travel caused by drum brake mechanical problems; determine needed repairs.
- 3. Remove, clean, inspect, and measure brake drums; follow manufacturers' recommendations in determining need to machine or replace.
- 4. Machine drums according to manufacturers' procedures and specifications.
- 5. Using proper safety procedures, remove, clean, and inspect brake shoes/linings, springs, pins, self-adjusters, levers, clips, brake backing (support) plates and other related brake hardware; determine needed repairs.
- Lubricate brake shoe support pads on backing (support) plate, self- adjuster mechanisms, and other brake hardware.
- 7. Inspect wheel cylinder(s) for leakage, operation, and mounting; remove and replace wheel cylinder(s).
- 8. Install brake shoes and related hardware.
- 9. Pre-adjust brake shoes and parking brake before installing brake drums or drum/hub assemblies and wheel bearings.
- 10. Reinstall wheel, torque lug nuts, and make final checks and adjustments.

# **A5 TASK LIST (CONTINUED)**

## C. Disc Brake Diagnosis and Repair (10 questions)

- Diagnose poor stopping, pulling, dragging, or incorrect pedal travel caused by disc brake hydraulic problems; determine needed repairs.
- Diagnose poor stopping, noise, pulling, grabbing, dragging, pedal pulsation or incorrect pedal travel caused by disc brake mechanical problems; determine needed
- repairs.

  3. Retract integral parking brake caliper piston(s) according to manufacturers recommendations.
- Remove caliper assembly from mountings; inspect for leaks and damage to caliper housing.
- 5. Clean, inspect, and measure caliper mountings and slides/pins for wear and damage.
- Remove, clean, and inspect pads and retaining hardware; determine needed repairs, adjustments, and replacements.
- Clean caliper assembly; inspect external parts for wear, rust, scoring, and damage; replace any damaged or worn parts; determine the need to repair or replace caliper assembly.
- Clean, inspect, and measure rotor with a dial indicator and a micrometer; follow manufacturers' recommendations in determining the need to index, machine or replace the rotor.
- 9. Remove and replace rotor.
- Machine rotor, using on-car or off-car method, according to manufacturers' procedures and specifications.
- 11. Install pads, calipers, and related attaching hardware; lubricate components following manufacturers' procedures and specifications; bleed system.
- Adjust calipers with integrated parking brakes according to manufacturers' recommendations.
- 13. Fill master cylinder to proper level with recommended fluid; inspect caliper for leaks.
- 14. Reinstall wheel, torque lug nuts, and make final checks and adjustments.
- Road test vehicle and burnish/break-in pads according to manufacturer's recommendations

#### D. Power Assist Units Diagnosis and Repair (4 questions)

- Test pedal free travel with and without engine running to check power booster operation.
- 2. Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.
- Inspect the vacuum-type power booster unit for vacuum leaks and proper operation; inspect the check valve for proper operation; repair, adjust, or replace parts as necessary.
- 4. Inspect and test hydro-boost system and accumulator for leaks and proper operation; repair or replace parts as necessary; refill system.

# **A5** TASK LIST (CONTINUED)

# E. Miscellaneous Systems (Pedal linkage, Wheel Bearings, Parking Brakes, Electrical, etc.) Diagnosis and Repair (7 questions)

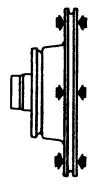
- Diagnose wheel bearing noises, wheel shimmy and vibration problems; determine needed repairs.
- 2. Remove, clean, inspect, repack wheel bearings, or replace wheel bearings and races; replace seals; replace hub and bearing assemblies; adjust wheel/hub bearings according to manufacturers' specifications.
- 3. Check parking brake system; inspect cables and parts for wear, rust, and corrosion; clean or replace parts as necessary; lubricate assembly.
- 4. Adjust parking brake assembly; check operation.
- 5. Test the parking brake indicator light, switch and wiring.
- 6. Test, adjust, repair or replace brake stop light switch, lamps, and related circuits.
- 7. Inspect and test brake pedal linkage for binding, looseness, and adjustment; determine needed repairs.

# F. Electronic Brake Control Systems: Antilock Brake System (ABS), Traction Control System (TCS), and Electronic Stability Control System (ESC) Diagnosis and Repair (7 questions)

- Follow manufacturers' service and safety precautions when inspecting, testing and servicing electronic brake control system, hydraulic, electrical, and mechanical components.
- Diagnose poor stopping, wheel lock up, false activation, pedal feel and travel, pedal pulsation, and noise concerns associated with the electronic brake control system; determine needed repairs.
- 3. Observe electronic brake control system indicator light(s) at startup and during road test; determine if further diagnosis is needed.
- 4. Diagnose electronic brake control system, electronic control(s), components, and circuits using on-board diagnosis and/or recommended test equipment; determine needed repairs.
- Bleed and/or flush the electronic brake control hydraulic system following manufacturers' procedures.
- Remove and install electronic brake control system components following manufacturers' procedures and specifications; observe proper placement of components and routing of wiring harness.
- 7. Test, diagnose and service electronic brake control system sensors (such as speed, yaw, steering angle, brake pedal position, etc.) and circuits following manufacturers' recommended procedures (includes output signal, resistance, shorts to voltage/ground, and frequency data.).
- 8. Diagnose electronic brake control system braking concerns caused by vehicle modifications (wheel/tire size, curb height, final drive ratio, etc.) and other vehicle mechanical and electrical/electronic modifications (communication, security, and radio, etc.).
- 9. Repair wiring harness and connectors following manufacturers' procedures.

# Sample Questions Brakes (Test A5)

#### **QUESTIONS:**



- 1. Which of these would most likely happen if the measurements in the set-up shown above varied from manufacturer's specs?
  - (A) Noisy Brake operation
- \* (C) Pulsating brake pedal

(B) Brake grab or pull

- (D) Low brake pedal
- 2. The brake pedal on a vehicle with power-assisted disc/drum brakes moves slowly to the floor during braking. Which of these could be the cause?
  - \* (A) A leaking master cylinder primary cup
    - (B) A leaking power brake booster
    - (C) A leaking master cylinder residual check valve
    - (D) An internal leak in the combination valve
- On a vehicle with disc/drum brakes, the front brakes grab quickly when light pedal pressure is applied. This could be caused by a bad:
  - (A) proportioning valve.
- \* (C) metering valve.
- (B) pressure differential valve.
- (D) residual check valve.
- 4. On a vehicle with single piston, floating caliper disc brakes, the disc brake pad between the caliper piston and the rotor is badly worn. The other brake pad is only slightly worn.

Technician A says that too much rotor runout could be the cause.

Technician B says that a frozen caliper piston could be the cause.

Who is right?
(A) A only

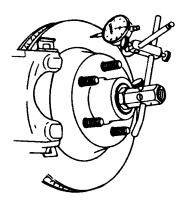
(C) Both A and B

(B) B only

\* (D) Neither A nor B

# **A5 SAMPLE QUESTIONS (CONTINUED)**

- 5. When the brakes are applied, a vibration comes from the front of a vehicle with a disc/drum system. Which of these could be the cause?
  - (A) Unequal tire pressure
  - (B) Binding caliper slides
  - \* (C) Excessive rotor runout
    - (D) A frozen caliper piston
- 6. 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.
- 7. A hydraulic brake line is leaking. Which of these is the correct repair?
  - (A) Cut out the bad section and replace with new steel tubing using compression fittings.
  - (B) Replace the leaking line with double-flared seamless copper tubing.
  - (C) Cut out the bad section and replace with single-flared steel tubing using flare nuts and unions.
  - \* (D) Replace the leaking line with double-flared steel tubing.



- 8. The set-up shown above is used to check:
  - (A) rotor parallelism.

- \* (C) rotor lateral runout (wobble).
- (B) wheel bearing adjustment.
- (D) rotor face wear.

# **A5 SAMPLE QUESTIONS (CONTINUED)**

- 9. The drag on a vehicle's drum brakes increases after each application until they lockup. Bleeding the system restores normal operation for a short time; then drag increases until the brakes lockup again. Which of these could be the cause?
  - \* (A) A blocked compensating port
    - (B) A blocked breather port
    - (C) Wrong brake shoe adjustment
    - (D) Weak brake shoe return springs
- 10. With the brakes applied, the pedal moves down slightly when the engine is started on a vehicle with power brakes.

Technician A says that the cause could be a leaking power brake booster diaphragm.

Technician B says that the cause could be a stuck closed check valve on the power brake booster manifold.

Who is right?

- (A) A only
- (B) B only
- (C) Both A and B
- \* (D) Neither A nor B

# Test Specifications and Task List Electrical/Electronic Systems (Test A6)

Content Area	Questions in Test	Percentage of Test	
A. General Electrical/Electronic System Diagnosis	13	26%	
B. Battery Diagnosis and Service	4	8%	
C. Starting System Diagnosis and Repair	5	10%	
D. Charging System Diagnosis and Repai	r 5	10%	
<ul> <li>E. Lighting Systems Diagnosis and Repai</li> <li>1. Headlights, Parking Lights, Taillights Dashlights, and Courtesy Lights (3)</li> <li>2. Stoplights, Turn Signals, Hazard Ligiand Back-up Lights (3)</li> </ul>	,	12%	
F. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Re	pair 6	12%	
<ul> <li>G. Horn and Wiper/Washer Diagnosis and Repair</li> </ul>	3	6%	
<ul><li>H. Accessories Diagnosis and Repair</li><li>1. Body (4)</li><li>2. Miscellaneous (4)</li></ul>	8	16%	
Total	50	100%	_

#### A. General Electrical/Electronic System Diagnosis (13 questions)

- 1. Check electrical circuits with a test light; determine needed repairs.
- Check voltages and voltage drops in electrical/electronic circuits; interpret readings and determine needed repairs.
- Check current flow in electrical/electronic circuits and components; interpret readings and determine needed repairs.
- 4. Check continuity and resistances in electrical/electronic circuits and components; interpret readings and determine needed repairs.
- 5. Check electronic circuit waveforms; interpret readings and determine needed repairs.
- Use scan-tool data to diagnose electronic systems; interpret readings and determine needed repairs.
- Check electrical/electronic circuits with appropriate jumper wires; determine needed repairs.

- 8. Find shorts, grounds, opens, and resistance problems in electrical/ electronic circuits; determine needed repairs.
- 9. Measure and diagnose the cause(s) of abnormal key-off battery drain (parasitic draw); determine needed repairs.
- 10. Inspect, test, and replace fusible links, circuit breakers, fuses, diodes, and current limiting devices.
- 11. Read and interpret electrical schematic diagrams and symbols.
- 12. Diagnose failures in the data bus communications network; determine needed repairs.

# **B. Battery Diagnosis and Service (4 questions)**

- 1. Perform battery state-of-charge test; determine needed service.
- 2. Perform battery capacity (load, high-rate discharge) test; determine needed service.
- 3. Maintain or restore electronic memory functions.
- 4. Inspect, clean, fill, or replace battery.
- Perform slow/fast battery charge in accordance with manufacturer's recommendations.
- Inspect, clean, and repair or replace battery cables, connectors, clamps and holddowns.
- Jump start a vehicle with jumper cables and a booster battery or auxiliary power supply.

#### C. Starting System Diagnosis and Repair (5 questions)

- 1. Perform starter current draw test; determine needed repairs.
- 2. Perform starter circuit voltage drop tests; determine needed repairs.
- Inspect, test, and repair or replace switches, connectors, and wires of starter control circuits.
- 4. Inspect, test, and replace starter relays and solenoids.
- 5. Remove and replace starter.
- Differentiate between electrical and engine mechanical problems that cause a slow crank or no crank condition.

# D. Charging System Diagnosis and Repair (5 questions)

Note: In 1996, SAE J1930 terminology was adopted to standardize component identification. This standard adopted the name "generator" to refer to the component commonly known as an "alternator". Both terms are used interchangeably in the ASE tests.

- 1. Diagnose charging system problems that cause an undercharge, a no-charge, or an overcharge condition.
- 2. Inspect, adjust, and replace generator (alternator) drive belts, pulleys, and tensioners.
- 3. Perform charging system voltage output test; determine needed repairs.
- 4. Perform charging system current output test; determine needed repairs.
- 5. Inspect, and test generator (alternator) control circuit; determine needed repairs.
- 6. Perform charging circuit voltage drop tests; determine needed repairs.
- 7. Inspect, repair, or replace connectors and wires of charging circuits.
- 8. Remove, inspect, and replace generator (alternator).

#### E. Lighting Systems Diagnosis and Repair (6 questions)

# 1. Headlights, Parking Lights, Taillights, Dash Lights, and Courtesy Lights (3 questions)

- Diagnose the cause of brighter than normal, intermittent, dim, continuous or no operation of headlights.
- 2. Inspect, test, and repair daytime running light systems.
- Inspect, replace, and aim headlights/bulbs including high-intensity discharge systems (HID), and auxiliary lights (fog lights/driving lights).
- 4. Inspect, test, and repair or replace headlight and dimmer switches, relays, control units, transformers, sensors, sockets, connectors, and wires of headlight circuits.
- 5. Diagnose the cause of brighter than normal, intermittent, dim, continuous or no operation of parking lights, taillights, and/or auxiliary lights (fog lights/driving lights).
- Inspect, test, and repair or replace switches, relays, bulbs, LEDs, sockets, connectors, wires, and controllers of parking light, taillight circuits, and auxiliary light circuits (fog lights/driving lights).
- Diagnose the cause of intermittent, dim, no lights, continuous operation, or no brightness control of instrument lighting circuits.
- 8. Inspect, test, and repair or replace switches, relays, bulbs, LEDs, sockets, connectors, wires, and controllers of instrument lighting circuits.
- 9. Diagnose the cause of intermittent, dim, continuous or no operation of courtesy lights (dome, map, vanity, cargo, trunk, and hood light).
- 10. Inspect, test, and repair or replace switches, relays, bulbs, sockets, connectors, wires, and controllers of courtesy light (dome, map, vanity, cargo, trunk, and hood light) circuits.

#### 2. Stoplights, Turn Signals, Hazard Lights, and Back-up Lights (3 guestions)

- 1. Diagnose the cause of intermittent, dim, continuous or no operation of stoplights (brake lights).
- 2. Inspect, test, adjust, and repair or replace switch, bulbs, LEDs, sockets, connectors, wires, and controllers of stoplight (brake light) circuits.
- 3. Diagnose the cause of no turn signal and/or hazard lights, or lights with no flash on one or both sides.
- Inspect, test, and repair or replace switches, flasher units, bulbs, sockets, connectors, wires, and controllers of turn signal and hazard light circuits.
- Diagnose the cause of intermittent, dim, improper, continuous or no operation of back-up lights.
- Inspect, test, and repair or replace switch, bulbs, sockets, connectors, wires, and controllers of back-up light circuits.
- 7. Inspect, test, repair or replace trailer wiring harness and connector.

# F. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair (6 questions)

*Note:* Diagnosing causes of abnormal charging system gauge readings or warning lights limited to dash units and their electrical connections; other causes of abnormal charging system indications are covered in category D.

- 1. Diagnose the cause of, high, low, intermittent or no gauge readings.
- 2. Inspect, test, and repair or replace gauges, gauge sending units, connectors, wires and controllers of gauge circuits.
- 3. Diagnose the cause(s) of high, low, intermittent, or no readings on electronic instrument clusters.
- 4. Inspect, test, repair or replace sensors, sending units, connectors, wires, and controllers of electronic instrument circuits.
- 5. Diagnose the cause of constant, intermittent, or no operation of warning light, indicator lights, and other driver information systems.
- Inspect, test, and repair or replace bulbs, sockets, connectors, wires, electronic components, and controllers of warning light, indicator light and driver information system circuits.
- 7. Diagnose the cause of constant, intermittent, or no operation of audible warning devices
- 8. Inspect, test, and repair or replace switches, relays, sensors, timers, electronic components, controllers, connectors, and wires of audible warning device circuits.

#### G. Horn and Wiper/Washer Diagnosis and Repair (3 questions)

- 1. Diagnose the cause of constant, intermittent, or no operation of horn(s).
- 2. Inspect, test, and repair or replace horn(s), horn relay, horn button (switch), connectors, wires, and controllers of horn circuits.
- 3. Diagnose the cause of wiper problems including constant operation, intermittent operation, poor speed control, no parking, or no operation of wiper.
- 4. Inspect, test, and replace intermittent (pulsing) wiper controls.
- 5. Inspect, test, and replace wiper motor, switches, relays, controllers, connections, and wires of wiper circuits.
- 6. Diagnose the cause of constant, intermittent, or no operation of window washer.
- 7. Inspect, test, and repair or replace washer motor, pump assembly, relays, switches, connectors, and wires of washer circuits.

#### H. Accessories Diagnosis and Repair (8 questions)

### 1. Body (4 questions)

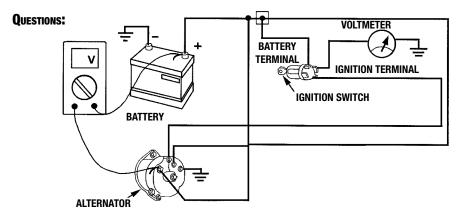
- 1. Diagnose the cause of slow, intermittent, or no operation of power windows.
- 2. Inspect, test, and repair or replace regulators (linkages), switches, controllers, relays, motors, connectors, and wires of power window circuits.
- 3. Diagnose the cause of slow, intermittent, or no operation of power seat, heated seat, and driver memory controls.
- 4. Inspect, test, adjust, and repair or replace power seat gear box, cables, switches, controllers, sensors, relays, solenoids, motors, connectors, and wires of power seat circuits, heated seat circuits, and driver memory controls.
- Diagnose the cause of constant, poor, intermittent, or no operation of rear window defogger.

- Inspect, test, and repair or replace switches, relays, timers, controllers, window grid, connectors, and wires of rear window defogger circuits.
- Diagnose the cause of constant, poor, intermittent, or no operation of electric door lock and hatch/trunk lock.
- 8. Inspect, test, and repair or replace switches, relays, controllers, actuators/solenoids, connectors, and wires of electric door lock/hatch/trunk circuits.
- Diagnose the cause of poor, intermittent, or no operation of keyless and remote lock/unlock devices.
- 10. Inspect, test, and repair or replace components, connectors, controllers, and wires of keyless and remote lock/unlock device circuits; reprogram system.
- 11. Diagnose the cause of slow, intermittent, or no operation of electrical sunroof/moonroof, convertible/retractable top, power sliding doors, and power liftgate.
- 12. Inspect, test, and repair or replace motors, switches, controllers, relays, connectors, and wires of electrically-operated sunroof/moonroof, convertible/retractable top, power sliding doors, and power liftgate circuits.
- 13. Diagnose the cause of poor, intermittent, or no operation of electrically operated/heated mirrors and driver memory controls.
- 14. Inspect, test and repair or replace motors, heated mirror grids, switches, controllers, sensors, relays, connectors, and wires of electrically operated/heated mirror circuits and driver memory controls.

#### 2. Miscellaneous (4 questions)

- 1. Diagnose the cause of poor sound quality, noisy, erratic, intermittent, or no operation of the audio system, remove and reinstall audio system component.
- 2. Inspect, test, and repair or replace speakers, amplifiers, remote controls, antennas, leads, grounds, connectors, and wires of sound system circuits.
- 3. Inspect, test, and repair or replace switches, relays, motor, connectors, and wires of power antenna circuits.
- 4. Inspect, test, and repair or replace case, fuse, connectors, relays, and wires of auxiliary power outlet circuits.
- 5. Inspect, test, and repair or replace clock, connectors, and wires of clock circuits.
- 6. Diagnose the cause of unregulated, intermittent, or no operation of cruise control.
- 7. Inspect, test, adjust, and repair or replace regulator, servo, hoses, switches, relays, electronic controller, speed sensors, connectors, and wires of cruise control circuits.
- 8. Diagnose the cause of false, intermittent, or no operation of anti-theft systems.
- Inspect, test, and repair or replace components, controllers, switches, relays, connectors, sensors, and wires of anti-theft system circuits.
- 10. Diagnose the causes(s) of the supplemental restraint/airbag warning light staying on or flashing.
- Disarm and enable the airbag system for vehicle service following manufacturers' recommended procedures.
- 12. Inspect, test, repair or replace the airbag(s), controller, sensors, connectors, ribbon wire/clock spring, and wires of the airbag system circuit(s). ■

# Sample Questions Electrical/Electronic Systems (Test A6)



- 1. In the charging system shown above, the meter reading will show:
  - (A) charging output voltage.
  - (B) regulator operating voltage.
  - \* (C) charging circuit voltage drop
    - (D) ignition switch voltage drop.
- 2. The oil pressure light stays on whenever the engine is running. The oil pressure has been checked and meets specs.

Technician A says that a ground in the circuit between the indicator light and the pressure switch could be the cause.

Technician B says that an open in the pressure switch could be the cause. Who is right?

\* (A) A only

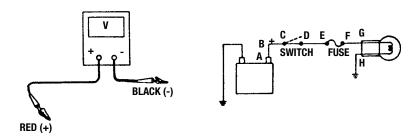
(C) Both A and B

(B) B only

(D) Neither A nor B

- 3. The passenger side power window operates properly when using the passenger side control switch, but the window will only operate in the DOWN position when using the driver's side master control switch. Which of these could be the cause?
  - (A) A pinched wire from the passenger side control switch to the window motor
  - (B) An open wire to the driver's side window motor
  - (C) A grounded power wire to the power window circuit breaker
  - \* (D) An open circuit in the driver's side master control switch

# **A6 SAMPLE QUESTIONS (CONTINUED)**



- 4. The bulb in the circuit shown above does not light. To find the <u>actual</u> voltage at the bulb, the technician should touch the red (+) probe of the voltmeter to:
  - (A) point A and the black (-) probe to ground.
  - (B) ground and the black (-) probe to point G.
  - \* (C) point G and the black (-) probe to ground.
    - (D) ground and the black (-) probe to point A.
- 5. Technician A says that if a fusible link in the alternator charging circuit is replaced with system sized wire, the circuit will be unprotected. Technician B says that if a fusible link in the alternator charging circuit is replaced with system sized wire, the battery will overcharge. Who is right?
  - \* (A) A only

(C) Both A and B

(B) B only

- (D) Neither A nor B
- 6. A starter solenoid clicks but the starter does not crank the engine.

  Technician A says that burned solenoid contacts could be the cause.

  Technician B says that a poor battery cable connection could be the cause.

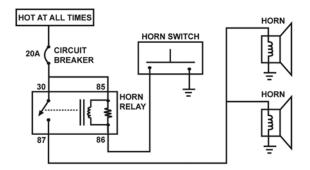
  Who is right?
  - (A) A only

\* (C) Both A and B

(B) B only

(D) Neither A nor B

#### **A6 SAMPLE QUESTIONS (CONTINUED)**



7. The horns in the circuit shown above only blow when a jumper wire is connected between terminals 30 and 87 of the horn relay.

Technician A says that a failed horn relay could be the cause.

Technician B says that a short-to-ground in the circuit between the horn relay and the horn button could be the cause.

Who is right?

\* (A) A only

(C) Both A and B

(B) B only

(D) Neither A nor B

#### Questions 8 and 9 are not like the ones above.

Each has the word **EXCEPT**. For each of these questions, look for the choice that could **NOT** cause the described situation. Read the entire question carefully before choosing your answer.

- 8. All of these could cause high starter current draw EXCEPT:
  - (A) worn starter bushings.
  - \* (B) a bad starter relay.
    - (C) grounded field coils.
    - (D) a grounded armature.
- 9. The starter will not "crank," and the solenoid does not "click" on a vehicle with an automatic transmission. All of these could be the cause EXCEPT:
  - (A) a misadjusted neutral safety switch.
  - \* (B) an open solenoid hold-in winding.
    - (C) an open circuit between the solenoid and the ignition switch.
    - (D) an open in the solenoid ground circuit.

# Test Specifications and Task List Heating and Air Conditioning (Test A7)

Content Area	Questions in Test	Percentage of Test
A. A/C System Service, Diagnosis, and F	Repair 13	26%
<ul> <li>B. Refrigeration System Component Diagnosis and Repair</li> <li>1. Compressor and Clutch (5)</li> <li>2. Evaporator, Condenser and Related Components (5)</li> </ul>	10	20%
C. Heating and Engine Cooling Systems Diagnosis and Repair	4	8%
<ul> <li>D. Operating Systems and Related Controls Diagnosis and Repair</li> <li>1. Electrical (10)</li> <li>2. Vacuum/Mechanical (2)</li> <li>3. Automatic and Semi-Automatic Heat Ventilating and A/C Systems (7)</li> </ul>	19	38%
E. Refrigerant Recovery, Recycling Handling, and Retrofit	4	8%
Total	50	100%

# A. A/C System Service, Diagnosis, and Repair (13 questions)

- 1. Identify system type and conduct performance test on the A/C system; determine needed repairs.
- Diagnose A/C system problems indicated by system pressures and/or temperature readings; determine needed repairs.
- Diagnose A/C system problems indicated by sight, sound, smell, and touch procedures; determine needed repairs.
- 4. Leak test A/C system; determine needed repairs.
- 5. Identify A/C system refrigerant and existing charge amount.
- 6. Evacuate A/C system.
- 7. Inspect A/C system components for contamination.
- 8. Charge A/C system with refrigerant (liquid or vapor).
- 9. Identify A/C system lubricant type and capacity.
- 10. Inspect and replace passenger compartment (cabin air, pollen) filter.
- 11. Disarm and enable the airbag system for vehicle service following manufacturers recommended procedures.

#### B. Refrigeration System Component Diagnosis and Repair (10 questions)

#### 1. Compressor and Clutch (5 questions)

- Diagnose A/C system problems that cause the protection devices (pressure, thermal, and electronic controls) to interrupt system operation; determine needed repairs.
- 2. Inspect, test, and replace A/C system pressure and thermal protection devices.
- 3. Inspect, adjust, and replace A/C compressor drive belts, pulleys and tensioners.
- 4. Inspect, test, service, and replace A/C compressor clutch components or assembly.
- 5. Identify required lubricant type; inspect and correct level in A/C compressor.
- 6. Inspect, test, service or replace A/C compressor.
- 7. Inspect, repair or replace A/C compressor mountings/fasteners.

#### 2. Evaporator, Condenser, and Related Components (5 questions)

- 1. Inspect, repair, or replace A/C system mufflers, hoses, lines, filters, fittings, and seals.
- 2. Inspect A/C condenser for misdirected or restricted air flow.
- 3. Inspect, test, and replace A/C system condenser, mountings, and air seals.
- 4. Inspect and replace receiver/drier or accumulator/drier.
- 5. Inspect, test, and replace expansion valve(s).
- 6. Inspect and replace orifice tube(s).
- 7. Inspect, test, clean, or replace evaporator(s).
- 8. Inspect, clean and repair evaporator housing, and water drain.
- 9. Inspect, test, and replace evaporator pressure/temperature control systems and devices.
- Identify, inspect, and replace A/C system service valves (gauge connections) and valve caps.
- 11. Inspect and replace A/C system high pressure relief device.

# C. Heating and Engine Cooling Systems Diagnosis and Repair (4 questions)

- 1. Diagnose the cause of temperature control problems in the heater/ventilation system; determine needed repairs.
- 2. Diagnose window fogging problems; determine needed repairs.
- 3. Perform engine cooling system tests; determine needed repairs.
- 4. Inspect and replace engine cooling and heater system hoses and pipes.
- Inspect, test, and replace radiator, pressure cap, coolant recovery system, and water pump.
- 6. Inspect, test, and replace thermostat, by-pass, and housing.
- 7. Identify, inspect, recover coolant; flush, and refill system with proper coolant.
- 8. Inspect, test, and replace fan, (both electrical and mechanical), fan clutch, fan belts, fan shroud, and air dams.
- Inspect, test, and replace heater coolant control valve (manual, vacuum, and electrical types) and auxiliary coolant pump.
- 10. Inspect, flush, and replace heater core.

#### D. Operating Systems and Related Controls Diagnosis and Repair (19 questions)

#### 1. Electrical (10 questions)

- 1. Diagnose the cause of failures in the electrical control system of heating, ventilating, and A/C systems; determine needed repairs.
- 2. Inspect, test, repair, and replace A/C-heater blower motors, resistors, switches, relay/modules, wiring, and protection devices.

- Inspect, test, repair, and replace A/C compressor clutch coil, relay/ modules, wiring, sensors, switches, diodes, and protection devices.
- 4. Inspect, test, repair, replace, and adjust A/C-related engine control systems.
- 5. Inspect, test, repair, replace, and adjust load sensitive A/C compressor cut-off systems.
- 6. Inspect, test, repair, and replace engine cooling/condenser fan motors, relays/modules, switches, sensors, wiring, and protection devices.
- 7. Inspect, test, adjust, repair and replace electric actuator motors, relays/ modules, switches, sensors, wiring, and protection devices (including dual/multi-zone systems).
- 8. Inspect, test, service, or replace heating, ventilating, and A/C control panel assemblies.

#### 2. Vacuum/Mechanical (2 questions)

- Diagnose the cause of failures in the vacuum and mechanical switches and controls
  of the heating, ventilating, and A/C systems; determine needed repairs.
- 2. Inspect, test, service, or replace heating, ventilating, and A/C control panel assemblies.
- Inspect, test, adjust, and replace heating, ventilating, and A/C control cables and linkages.
- Inspect, test, and replace heating, ventilating, and A/C vacuum actuators (diaphragms/motors) and hoses.
- 5. Identify, inspect, test, and replace heating, ventilating, and A/C vacuum reservoir, check valve, and restrictors.
- 6. Inspect, test, adjust, repair, or replace heating, ventilating, and A/C ducts, doors, and outlets (including dual/multi-zone systems).

### Automatic and Semi-Automatic Heating, Ventilating, and A/C Systems (7 questions)

- 1. Diagnose temperature control system problems; determine needed repairs.
- 2. Diagnose blower system problems; determine needed repairs.
- Diagnose air distribution system problems; determine needed repairs (including dual/ multi-zone systems).
- 4. Diagnose compressor clutch control system; determine needed repairs.
- 5. Inspect, test, adjust or replace climate and blower control sensors.
- 6. Inspect, test, adjust, and replace door actuator(s).
- 7. Inspect, test, and replace heater water valve and controls.
- 8. Inspect, test, and replace electric and vacuum motors, solenoids, and switches.
- 9. Inspect, test, and replace Automatic Temperature Control (ATC) control panel and/or climate control computer (microprocessor/programmer).
- 10. Check and adjust calibration of Automatic Temperature Control (ATC) system.
- 11. Diagnose data communication issues that affect A/C system operation.

### E. Refrigerant Recovery, Recycling, Handling and Retrofit (4 questions)

- 1. Maintain and verify correct operation of certified equipment.
- 2. Identify, and recover A/C system refrigerant.
- 3. Recycle or properly dispose of refrigerant.
- 4. Label and store refrigerant.
- 5. Test recycled refrigerant for non-condensable gases.
- 6. Follow Federal and local guidelines for retrofit procedures. ■

# Sample Questions Heating and Air Conditioning (Test A7)

#### QUESTIONS:

- 1. Prior to recovery, an unknown refrigerant is identified. The technician should:
  - (A) discharge it into the atmosphere.
  - \* (B) recover it and treat it as contaminated.
    - (C) recover it and recycle it as R-12.
    - (D) recover it and recycle it as R-134a.
- 2. A compressor clutch will not engage, but there is 14.2v and a good ground at the clutch coil connector. Which of these could be the cause?
  - (A) A low refrigerant level
  - (B) A locked-up compressor
  - \* (C) An incorrect air gap
    - (D) A bad pressure cycling switch
- Technician A says that evacuating an A/C system will remove air and moisture from the system.

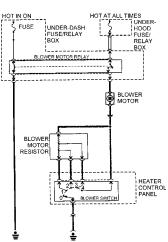
Technician B says that evacuating an A/C system will remove dirt particles from the system.

Who is right?

- \*(A) A only
  - (B) B only
  - (C) Both A and B
  - (D) Neither A nor B
- 4. The blower motor in the schematic shown works only with the blower switch in the Number 4 position.

This could be caused by a failed:

- (A) blower motor.
- (B) blower motor ground.
- (C) blower motor relay.
- \* (D) blower motor resistor.



# A7 SAMPLE QUESTIONS (CONTINUED)

- 5. To charge an A/C system while it is running, the refrigerant should be added to:
  - (A) the high side only.
  - \* (B) the low side only.
    - (C) both the high and the low sides.
    - (D) either the high or the low side.
- 6. With the A/C system operating at an ambient (outside) temperature of 85° F, the low pressure guage reads 5 psi and the high pressure guage reads 105 psi. What do these readings indicate?
  - (A) Normal operation
  - \* (B) Low refrigerant level
    - (C) A restriction in the high side
    - (D) Broken compressor reed valves
- 7. The technician measures 14.2 volts at the A/C clutch coil, but the A/C clutch will not engage.

Technician A says that a bad clutch coil could be the cause.

Technician B says that a bad clutch coil ground could be the cause.

Who is right?

(A) A only

\* (C) Both A and B

(B) B only

(D) Neither A nor B

#### Question 8 is not like the ones above.

It has the word **EXCEPT**. For this question, look for the choice that could **NOT** cause the described situation. Read the entire question carefully before choosing your answer.

- 8. The high side pressure in an A/C system is above specs. All of these could be the cause EXCEPT:
  - (A) an overcharge of refrigerant.
  - (B) a restricted air flow across the condenser.
  - (C) a plugged expansion valve.
  - \* (D) a broken compressor reed valve.

# Test Specifications and Task List Engine Performance (Test A8)

Content Area	Questions in Test	Percentage of Test	
A. General Diagnosis	12	24%	
B. Ignition System Diagnosis and Repair	8	16%	
<ul> <li>Fuel, Air Induction and Exhaust System Diagnosis and Repair</li> </ul>	s 9	18%	
<ul> <li>D. Emissions Control Systems Diagnosis and Repair (Including OBD II)</li> <li>1. Positive Crankcase Ventilation (1)</li> <li>2. Exhaust Gas Recirculation (2)</li> <li>3. Secondary Air Injection (AIR) and Catalytic Converter (2)</li> <li>4. Evaporative Emissions Controls (3)</li> </ul>	8	16%	
<ul><li>E. Computerized Engine Controls Diagnos and Repair (Including OBD II)</li></ul>	iis 13	26%	
Total	50	100%	

### A. General Diagnosis (12 questions)

- Verify driver's complaint, perform visual inspection, and/or road test vehicle; determine needed action.
- Research applicable vehicle and service information, such as engine management system operation, vehicle service history, service precautions, technical service bulletins, and service campaigns/recalls.
- Diagnose noises and/or vibration problems related to engine performance; determine needed action.
- 4. Diagnose the cause of unusual exhaust color, odor, and sound; determine needed action.
- 5. Perform engine manifold vacuum or pressure tests; determine needed action.
- 6. Perform cylinder power balance test; determine needed action.
- 7. Perform cylinder cranking compression test; determine needed action.
- 8. Perform cylinder leakage/leak-down test; determine needed action.

- 9. Diagnose engine mechanical, electrical, electronic, fuel, and ignition problems with an oscilloscope, engine analyzer, and/or scan tool; determine needed action.
- 10. Prepare and inspect vehicle for HC, CO, CO2, and O2 exhaust gas analysis; perform test and interpret exhaust gas readings.
- 11. Verify valve adjustment on engines with mechanical or hydraulic lifters.
- Verify camshaft timing (including engines equipped with variable valve timing); determine needed action.
- 13. Verify engine operating temperature, check coolant level and condition, perform cooling system pressure test; determine needed repairs.
- 14. Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, and fan control devices; determine needed repairs.
- 15. Read and interpret electrical schematic diagrams and symbols.
- 16. Test and diagnose emissions or driveability problems caused by battery condition, connections, or excessive key-off battery drain; determine needed repairs.
- 17. Perform starter current draw test; determine needed action.
- 18. Perform starter circuit voltage drop tests; determine needed action.
- 19. Inspect, test, and repair or replace components and wires in the starter control circuit.
- Test and diagnose engine performance problems resulting from an undercharge, overcharge, or a no-charge condition; determine needed action.
- 21. Inspect, adjust, and replace alternator (generator) drive belts, pulleys, tensioners and fans.
- 22. Inspect, test, and repair or replace charging circuit components, connectors and wires.

#### **B. Ignition System Diagnosis And Repair (8 questions)**

- 1. Diagnose ignition system related problems such as no-starting, hard starting, engine misfire, poor driveability, spark knock, power loss, poor mileage, and emissions problems; determine root cause; determine needed repairs.
- 2. Interpret ignition system related diagnostic trouble codes (DTCs); determine needed repairs.
- 3. Inspect, test, repair, or replace ignition primary circuit wiring and components.
- 4. Inspect, test, service, repair or replace ignition system secondary circuit wiring and components.
- 5. Inspect, test, and replace ignition coil(s).
- 6. Inspect, test, and replace ignition system sensors; adjust as necessary.
- Inspect, test, and/or replace ignition control module (ICM)/powertrain/engine control module (PCM/ECM); reprogram as needed.

#### C. Fuel, Air Induction, And Exhaust System Diagnosis And Repair (9 questions)

- 1. Diagnose fuel system related problems, including hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, and emissions problems; determine root cause; determine needed action.
- 2. Interpret fuel or induction system related diagnostic trouble codes (DTCs); analyze fuel trim and other scan tool data; determine needed repairs.
- 3. Inspect fuel tank, filler neck, and gas cap; inspect and replace fuel lines, fittings, and hoses; check fuel for contaminants and quality.
- 4. Inspect, test, and replace fuel pump(s) and/or fuel pump assembly; inspect, service, and replace fuel filters.

- Inspect and test electric fuel pump control circuits and components; determine needed repairs.
- 6. Inspect, test, and repair or replace fuel pressure regulation system and components of fuel injection systems; perform fuel pressure/volume test.
- 7. Inspect, remove, service or replace throttle assembly; make related adjustments.
- 8. Inspect, test, clean, and replace fuel injectors and fuel rails.
- 9. Inspect, service, and repair or replace air filtration system components.
- Inspect throttle assembly, air induction system, intake manifold and gaskets for air/vacuum leaks and/or unmetered air.
- 11. Remove, clean, inspect, test, and repair or replace fuel system vacuum and electrical components and connections.
- 12. Inspect, service, and replace exhaust manifold, exhaust pipes, oxygen sensors, mufflers, catalytic converters, resonators, tailpipes, and heat shields.
- 13. Test for exhaust system restriction or leaks; determine needed action.
- Inspect, test, clean and repair or replace turbocharger or supercharger and system components.

# D. Emissions Control Systems Diagnosis And Repair (Including OBD II) (8 questions)

#### 1. Positive Crankcase Ventilation (1 question)

- 1. Test and diagnose emissions or driveability problems caused by positive crankcase ventilation (PCV) system.
- 2. Inspect, service, and replace positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifice/metering device, and hoses.

### 2. Exhaust Gas Recirculation (2 questions)

- 1. Test and diagnose driveability problems caused by the exhaust gas recirculation (EGR) system.
- Interpret exhaust gas recirculation (EGR) related scan tool data and diagnostic trouble codes (DTCs); determine needed repairs.
- 3. Inspect, test, service, and replace components of the EGR system, including EGR valve, tubing, passages, vacuum/pressure controls, filters, hoses, electrical/electronic sensors, controls, solenoids and wiring of exhaust gas recirculation (EGR) systems.

# 3. Secondary Air Injection (AIR) And Catalytic Converter (2 questions)

- Test and diagnose emissions or driveability problems caused by the secondary air injection or catalytic converter systems.
- Interpret secondary air injection system related scan tool data and diagnostic trouble codes (DTCs); determine needed repairs.
- Inspect, test, service, and replace mechanical components and electrical/electronically-operated components and circuits of secondary air injection systems.
- 4. Inspect catalytic converter. Interpret catalytic converter related diagnostic trouble codes (DTCs); analyze related scan tool data to determine root cause of DTCs; determine needed repairs.

#### 4. Evaporative Emissions Controls (3 questions)

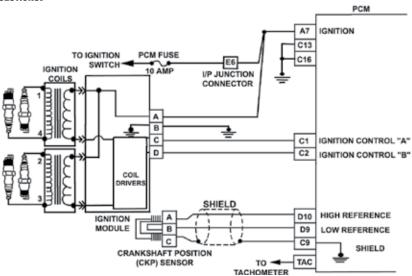
- Test and diagnose emissions or driveability problems caused by the evaporative emissions control system.
- 2. Interpret evaporative emissions-related scan tool data and diagnostic trouble codes (DTCs); determine needed repairs.
- 3. Inspect, test, and replace canister, lines/hoses, mechanical and electrical components of the evaporative emissions control system.

# E. Computerized Engine Controls Diagnosis And Repair (Including OBD II) (13 questions)

- 1. Retrieve and record diagnostic trouble codes (DTCs), OBD II monitor status and freeze frame data.
- Diagnose the causes of emissions or driveability problems with stored or active diagnostic trouble codes (DTCs).
- Diagnose the causes of emissions or driveability problems without diagnostic trouble codes (DTCs).
- 4. Use a scan tool, digital multimeter (DMM), or digital storage oscilloscope (DSO) to inspect or test computerized engine control system sensors, actuators, circuits, and powertrain/engine control module (PCM/ECM); determine needed repairs.
- Measure and interpret voltage, voltage drop, amperage, and resistance using digital multimeter (DMM) readings.
- Test, remove, inspect, clean, service, and repair or replace power and ground distribution circuits and connections.
- Remove and replace the powertrain/engine control module (PCM/ECM); reprogram as needed.
- 8. Diagnose driveability and emissions problems resulting from failures of interrelated systems (for example: cruise control, security alarms/theft deterrent, torque controls, traction controls, torque management, A/C, non-OEM installed accessories).
- Clear diagnostic trouble codes (DTCs), run all OBD II monitors, and verify the repair.

# Sample Questions Engine Performance (Test A8)

#### QUESTIONS:



1. An engine equipped with the ignition system shown above misfires on cylinders #1 and #4.

Technician A says that a failed ignition coil could be the cause. Technician B says that a weak rpm signal to the PCM could be the cause. Who is right.

\* (A) A only

(C) Both A and B

(B) B only

- (D) Neither A nor B
- 2. While the engine is running, a technician pulls the PCV valve out of the valve cover and plugs the valve opening. There are no changes in engine operation. Technician A says that the PCV valve could be stuck in the open position. Technician B says that the hose between the intake manifold and the PCV valve could be plugged.

Who is right?

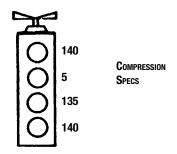
(A) A only

(C) Both A and B

\* (B) B only

(D) Neither A nor B

# A8 SAMPLE QUESTIONS (CONTINUED)



- 3. After the compression readings shown above were taken, a wet compression test was made. The second set of readings was almost the same as the first. Technician A says that a burned valve could cause these readings. Technician B says that a broken piston ring could cause these readings. Who is right?
  - \* (A) A only

(C) Both A and B

(B) B only

- (D) Neither A nor B
- 4. Blue smoke comes from the exhaust pipe of a vehicle.

  Technician A says that blocked cylinder head oil return passages could be the

cause. Technician B says that a stuck open thermostat could be the cause. Who is right?

(C) Both A and B

\* (A) A only (B) B only

(D) Neither A nor B

5. A vehicle with a computer-controlled (feedback) engine has poor gas mileage. Engine tests show a rich mixture.

Technician A says that a bad oxygen  $(O_2)$  sensor could be the cause.

Technician B says that a bad engine coolant temperature sensor could be the cause.

Who is right?

(A) A only

\* (C) Both A and B

(B) B only

(D) Neither A nor B

- 6. A vacuum gauge is connected to the intake manifold of an engine and the engine is run at 2,000 rpm. During the test, the pointer on the gauge fluctuates rapidly between readings of 10 and 22 inches of vacuum. These test results point to:
  - (A) a leaking intake manifold gasket.
  - (B) worn piston rings.
  - (C) worn valve guides.
  - \* (D) a weak or broken valve spring.

#### A8 SAMPLE QUESTIONS (CONTINUED)

- 7. The technician finds no spark and no injector pulses on a vehicle that will not start. The most likely cause is a failed:
  - (A) mass air flow sensor (MAF).
  - \* (B) crankshaft position sensor (CKP).
    - (C) throttle position sensor (TPS).
    - (D) fuel pump module (FP).
- 8. An engine with an electronic fuel injection (EFI) system has high fuel pressure at idle. Which of these could be the cause?
  - \* (A) Low manifold vacuum
    - (B) A leaking fuel pump check valve
    - (C) A plugged fuel injector
    - (D) High manifold vacuum
- 9. Which of these can cause a catalytic converter to overheat?
  - (A) A broken air pump drive belt
  - (B) A plugged canister purge vacuum hose
  - (C) A failed exhaust gas recirculation (EGR) valve
  - \* (D) A disconnected spark plug wire

# Question 10 is not like the ones above.

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.

- 10. Engine detonation (knock) could be caused by any of these EXCEPT:
  - (A) a lean air fuel mixture.
  - \* (B) retarded ignition timing.
    - (C) excess carbon in the combustion chambers.
    - (D) a stuck-closed exhaust gas recirculation (EGR) valve.

# Test Specifications and Task List Light Vehicle Diesel Engines (Test A9)

Content Area	Questions in Test*	Percentage of Test
A. General Diagnosis     B. Cylinder Head and Valve Train	9	18%
Diagnosis and Repair	5	10%
C. Engine Block Diagnosis and Repair	5	10%
<ul><li>D. Lubrication and Cooling Systems</li><li>Diagnosis and Repair</li></ul>	6	12%
E. Air Induction and Exhaust Systems     Diagnosis and Repair	12	24%
F. Fuel System Diagnosis and Repair	13	26%
Total	50	100%

#### A. General Diagnosis (9 questions)

- 1. Verify the complaint, and road/dyno test vehicle; review driver/customer concerns and vehicle service history (if available); determine further diagnosis.
- Record vehicle identification number (VIN). Identify engine model, calibration and serial numbers to research applicable vehicle and service information, service precautions, and technical service bulletins; determine needed actions.
- Perform scan tool check and visual inspection for physical damage and missing, modified, or tampered components; determine needed repairs.
- 4. Check, and record electronic diagnostic codes, freeze frame and/or operational data; monitor scan tool data; clear codes; determine further diagnosis.
- 5. Inspect engine assembly and compartment for fuel, oil, coolant, exhaust, or other leaks; determine needed repairs.
- Inspect engine compartment wiring harness, connectors, seals, and locks; check for proper routing and condition; determine needed repairs.
- 7. Listen for and isolate engine noises; determine needed repairs.
- 8. Isolate and diagnose engine related vibration problems; determine needed actions.
- 9. Check engine exhaust for odor and smoke color; determine further diagnosis.
- Check fuel for contamination, quantity, quality, and consumption; determine needed actions.
- 11. Perform crankcase pressure test; determine further diagnosis.
- 12. Diagnose surging, rough operation, misfiring, low power, slow deceleration, slow acceleration and shutdown problems; determine needed actions.

- 13. Check cooling system for freeze point, level, contamination, temperature, pressure, circulation, and fan operation; determine needed repairs.
- 14. Check lubrication system for contamination, oil level, temperature, pressure, filtration, and oil consumption; determine needed repairs.
- 15. Diagnose no cranking, cranks but fails to start, hard starting, and starts but does not continue to run problems; determine needed actions.
- 16. Diagnose engine problems caused by battery condition, connections, or excessive key-off battery drain; determine needed repairs.
- 17. Diagnose engine problems resulting from an undercharge, overcharge, or a no-charge condition; determine needed action.

# B. Cylinder Head and Valve Train Diagnosis and Repair (5 questions)

- 1. Remove, inspect, disassemble, and clean cylinder head assembly(s).
- 2. Inspect threaded holes, studs, and bolts for serviceability; service/replace as needed.
- Measure cylinder head thickness, and check mating surfaces for warpage and surface finish; inspect for cracks/damage; check condition of passages; inspect core and gallery plugs; determine serviceability and needed repairs.
- 4. Inspect valves, guides, seats, springs, retainers, rotators, locks and seals; determine serviceability and needed repairs.
- 5. Inspect and/or replace injector sleeves, glow plug sleeves, and seals; pressure test to verify repair (if applicable); measure injector tip, nozzle, or prechamber protrusion where specified by manufacturer.
- Inspect, and/or replace valve bridges (crossheads) and guides; adjust bridges (crossheads) if applicable.
- Reassemble, check, and install cylinder head assembly and gasket as specified by the manufacturer.
- 8. Inspect pushrods, rocker arms, rocker arm shafts, electronic wiring harness, and brackets; repair/replace as needed.
- 9. Inspect, install, and adjust cam followers and retainers; adjust valve clearance.
- Inspect, measure, and replace/reinstall overhead camshaft and bearings; measure and adjust endplay.

#### C. Engine Block Diagnosis and Repair (5 questions)

- 1. Remove, inspect, service, and install pans, covers, ventilation systems, gaskets, seals, and wear rings.
- 2. Disassemble, clean and inspect engine block for cracks; check mating surfaces and related components for damage or warpage and surface finish; check deck height; check condition of passages, core, and gallery plugs; inspect threaded holes, studs, dowel pins and bolts for serviceability; service/replace as needed.
- 3. Inspect and measure cylinder walls for wear and damage; determine needed service.
- 4. Inspect in-block camshaft bearings for wear and damage; replace as needed.
- Inspect, measure, and replace/reinstall in-block camshaft; check and correct end play; inspect, replace/reinstall, and adjust cam followers (if applicable).
- 6. Clean and inspect crankshaft and journals for surface cracks and damage; check condition of oil passages; check passage plugs; measure journal diameters; check mounting surfaces; determine needed service.

- Determine the proper select-fit components such as pistons, connecting rod and main bearings.
- 8. Inspect and replace main bearings; check cap fit and bearing clearances; check and correct crankshaft end play.
- Inspect and time the drive gear train components (includes gear, chain, and belt systems).
- 10. Inspect, measure, or replace pistons, pins, and retainers.
- 11. Measure piston-to-cylinder wall clearance.
- 12. Identify piston, connecting rod bearing, and main bearing wear patterns that indicate connecting rod and crankshaft alignment or bearing bore problems; check bearing bore and bushing condition; determine needed repairs.
- 13. Check ring-to-groove fit and end gaps; install rings on pistons. Assemble pistons and connecting rods and install in block; check piston height/protrusion; check liner height/protrusion (if applicable); replace rod bearings and check clearances; check condition, position, and clearance of piston cooling jets (nozzles).
- 14. Inspect crankshaft vibration damper.
- 15. Inspect flywheel/flexplate and/or dual-mass flywheel (including ring gear) and mounting surfaces for cracks, wear, and runout; determine needed repairs.

#### D. Lubrication and Cooling Systems Diagnosis and Repair (6 questions)

- 1. Verify engine oil pressure and check operation of pressure sensor/switch and pressure gauge; verify engine oil temperature and check operation of temperature sensor.
- Inspect, measure, repair/replace oil pump, housing, drives, pipes, and screens; check drive gear clearance.
- 3. Inspect, repair/replace oil pressure regulator valve(s), and by-pass valve(s).
- 4. Inspect, clean, test, reinstall/replace oil cooler, by-pass valve, lines and hoses.
- 5. Inspect turbocharger lubrication and cooling systems; repair/replace as needed.
- 6. Change engine oil and filters; add proper type, viscosity, and rating of oil.
- Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment.
- 8. Verify coolant temperature; check operation of temperature and level sensors, switch, and temperature gauge.
- 9. Inspect and replace thermostat(s), by-passes, housing(s), and seals.
- 10. Flush and refill cooling system; add proper coolant type; bleed air from system.
- 11. Inspect and replace water pump, housing, hoses, and idler pulley or drive gear.
- 12. Inspect radiator, pressure cap, and tank(s); pressure test cooling system and radiator cap; determine needed repairs.
- 13. Inspect, repair/replace fan, fan hub, clutch, controls, and shroud.

### E. Air Induction and Exhaust Systems Diagnosis and Repair (12 questions)

- 1. Perform air intake system restriction and leakage tests; determine needed actions.
- 2. Perform intake manifold pressure tests; determine needed actions.
- 3. Inspect, service/replace air induction piping, air cleaner, and element.
- 4. Inspect test, and replace turbocharger(s) (including variable ratio/geometry VGT), pneumatic, hydraulic, and electronic controls and actuators; inspect, test, and replace wastegate and wastegate controls.
- Inspect and replace intake manifold, gaskets, temperature and pressure sensors, and connections.

- 6. Inspect, test, clean, replace charge air cooler and piping system.
- 7. Perform exhaust back pressure and temperature tests; determine needed actions.
- 8. Inspect, repair/replace exhaust manifold, gaskets, piping, mufflers, exhaust after treatment devices, and mounting hardware.
- 9. Inspect, test, and repair/replace preheater/inlet air heater, and/or glow plug system and controls.
- Inspect, test, and replace exhaust after treatment system components and controls; check regeneration system.
- 11. Inspect, test, service, and replace EGR system components; including EGR valve(s), cooler(s), piping, electronic sensors, controls, and wiring.
- 12. Inspect, test, and replace EGR air-flow control (throttle) valve and controls.
- 13. Inspect, test, and replace crankcase ventilation system components.

#### F. Fuel System Diagnosis and Repair (13 questions)

- Inspect, clean, test, and repair/replace fuel system tanks, vents, caps, mounts, valves, single/dual supply and return lines, and fittings.
- Inspect, clean, test, repair / replace fuel transfer and / or supply pump, strainers, fuel/water separators/indicators, filters, heaters, coolers, ECM cooling plates (if applicable), and mounting hardware.
- 3. Check fuel system for air; determine needed repairs; prime and bleed fuel system; check, repair/replace primer pump.
- 4. Inspect, test, repair/replace low pressure regulator supply and return systems.
- Inspect, reinstall/replace high-pressure injection lines, fittings, seals, and mounting hardware.
- Inspect, adjust, repair/replace electronic throttle and PTO control devices, circuits, and sensors.
- 7. Perform on-engine inspections, tests, and replace high pressure common rail fuel system components and electronic controls.
- 8. Perform on-engine inspections, tests, and replace hydraulic electronic unit injectors (HEUI) components and electronic controls (rail pressure control).
- 9. Perform on-engine inspections, tests, and replace pump-line-nozzle fuel system (PLN-E) components and electronic controls.
- Perform on-engine inspections, tests and replace electronic unit injectors (EUI) components and electronic controls.
- 11. Inspect and replace electrical connector terminals, pins, harnesses, seals, and locks.
- 12. Connect diagnostic tool to vehicle/engine; access, verify and update software calibration settings; perform ECM re-learn procedures as needed.
- 13. Use a diagnostic tool (hand-held or PC based) to inspect and test electronic engine control system, sensors, actuators, electronic control modules (ECMs/PCMs), and circuits; determine further diagnosis.
- 14. Measure and interpret voltage, voltage drop, amperage, and resistance readings using a digital multimeter (DMM) or appropriate test equipment.
- 15. Diagnose engine problems resulting from failures of inter-related systems (for example: cruise control, security alarms/theft deterrent, transmission controls, electronic stability control, non-OEM installed accessories). ■

# Sample Questions Light Vehicle Diesel Engines (Test A9)

#### QUESTIONS:

- 1. An electronic diesel engine has an active diagnostic trouble code for "single cylinder #3 misfire." This could be caused by:
  - \* (A) low compression in the #3 cylinder.
    - (B) an open #3 cylinder glow plug.
    - (C) a shorted #3 cylinder glow plug.
    - (D) an incorrect fuel cetane rating.
- 2. A vehicle has low power under load. Which of these could be the cause?
  - \* (A) A leaking charge air cooler
    - (B) A leak in the turbocharger inlet piping
    - (C) Using an off road grade of fuel
    - (D) An open in the mass airflow sensor circuit
- A vehicle equipped with a HEUI fuel system is hard to start at engine temperatures lower than 35° F (1.7° C).

Technician A says that worn injectors could be the cause.

Technician B says that an open glow plug could be the cause.

Who is right?

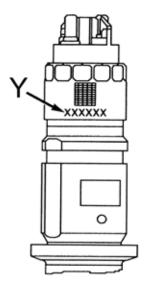
- \* (A) A only
  - (B) B only
  - (C) Both A and B
  - (D) Neither A nor B
- 4. Technician A says that the vanes in a variable geometry turbo (VGT) system are closed at W.O.T.

Technician B says that sticking vanes in a variable geometry turbo (VGT) system can be determined by observing the MAF sensor voltage readings on a scan tool.

Who is right?

- (A) A only
- (B) B only
- (C) Both A and B
- \* (D) Neither A nor B

# **A9 SAMPLE QUESTIONS (CONTINUED)**



- An electronic fuel injector on a diesel engine with a high-pressure common 5. rail injection system is being replaced. The information at point "Y" in the illustration show above indicates the injector:
  - (A) bar code.
  - (B) maximum pressure rating.
  - (C) opening pressure.
  - \* (D) calibration coding.
- The owner of a diesel vehicle complains of a serious vibration at idle. Any of these could be the cause EXCEPT:
  - - (A) a broken motor mount.
    - (B) misfiring cylinders.
  - (C) an incorrect idle speed.
  - \* (D) a stuck-closed EGR valve.

# Test Specifications and Task List Automobile Service Consultant (Test C1)

Content Area	Questions in Test*	Percentage of Test	
<ul><li>A. Communications</li><li>1. Customer Relations (12)</li><li>2. Sales Skills (10)</li><li>3. Internal Relations (4)</li></ul>	26	52%	
<ol> <li>B. Product Knowledge</li> <li>1. Engine Systems (Includes Mechanic Cooling, Fuel, Ignition, Exhaust, Emissions Control, and Starting/Charging) (4)</li> <li>2. Drive Train Systems (Includes Manu Transmission/Transaxles, Automatic Transmission/Transaxles and Drive Train Components) (3)</li> <li>3. Chassis Systems (Includes Frames, ABS, Traction Control, Suspension, Steering, Wheels, Tires, and TPMS)</li> <li>4. Body Systems (Includes Heating an Air Conditioning, Electrical, Restrain and Accessories) (3)</li> <li>5. Services/Maintenance Intervals (3)</li> <li>6. Warranty, Service Contracts, Service Bulletins, and Campaigns/Recalls (2)</li> <li>7. Vehicle Identification (2)</li> </ol>	Brakes, (4) d t,	42%	
C. Shop Operations	3	6%	
Total	50	100%	

# A. Communications (26 questions)

#### 1. Customer Relations (12 questions)

- 1. Demonstrate proper telephone skills.
- 2. Obtain, confirm, and document pertinent vehicle/customer contact information.
- 3. Identify, verify, and document customer concern/request.
- 4. Demonstrate appropriate greeting skills.
- 5. Discuss alternative transportation options.
- 6. Promote procedures, benefits, and capabilities of service facility.
- 7. Review vehicle service history.
- 8. Identify and recommend service and maintenance needs.

- 9. Establish job status/completion expectations.
- 10. Confirm the accuracy of the repair order and obtain repair authorization.
- Identify customer type (first time, warranty, repeat repair, fleet, etc.) and method of payment.
- 12. Present professional image.
- 13. Perform customer follow-up.
- 14. Explain and confirm understanding of work performed, charges, and warranties.

#### 2. Sales Skills (10 questions)

- 1. Provide and explain estimates.
- 2. Identify and prioritize vehicle needs.
- 3. Address original concerns with customer.
- 4. Communicate the value of related and additional services.
- 5. Explain product/service features and benefits.
- 6. Overcome objections/finalize sale.

#### 3. Internal Relations (4 questions)

- 1. Effectively communicate customer service concern/request.
- 2. Understand the technician's diagnosis and service recommendations.
- 3. Verify availability of repair parts.
- 4. Establish completion expectations.
- 5. Monitor repair progress/quality control.
- 6. Document information about services performed or recommended.
- 7. Communicate with shop personnel about shop production/efficiency.
- 8. Maintain open lines of communication within the organization.

#### **B. Product Knowledge (21 questions)**

# 1. Engine Systems (4 questions)

(Includes Mechanical, Cooling, Fuel, Ignition, Exhaust, Emissions Control, and Starting/Charging)

- 1. Identify major components and location.
- 2. Identify component function.
- 3. Identify related items

#### 2. Drive Train Systems (3 questions)

# (Includes Manual Transmission/Transaxles, Automatic Transmission/Transaxles, and Drive Train Components)

- 1. Identify major components and location.
- 2. Identify component function.
- 3. Identify related items.

#### 3. Chassis Systems (4 questions)

(Includes Frames, Brakes, ABS, Traction Control, Suspension, Steering, Wheels, Tires, and TPMS)

- 1. Identify major components and location.
- 2. Identify component function.
- 3. Identify related items.

#### 4. Body Systems (3 questions)

(Includes Body Components, Glass, Heating and Air Conditioning, Electrical, Restraint, and Accessories)

- 1. Identify major components and location.
- 2. Identify component function.
- 3. Identify related items.

#### 5. Services/Maintenance Intervals (3 questions)

- 1. Understand the elements of a maintenance procedure.
- 2. Identify related maintenance and reset procedures.
- 3. Locate and interpret maintenance schedule information.

# 6. Warranty, Service Contracts, Service Bulletins, and Campaigns/Recalls (2 questions)

- 1. Demonstrate knowledge of warranty policies and procedures/parameters.
- 2. Locate and use reference information for warranties, service contracts, service bulletins, and campaigns/recalls.
- 3. Demonstrate knowledge of service contracts, technical service bulletins, and campaign/recall procedures.
- 4. Verify applicability of warranty, service contracts, and campaigns/recalls.

# 7. Vehicle Identification (2 questions)

- 1. Locate and utilize vehicle ID number (VIN).
- 2. Locate production date.
- 3. Locate and utilize component identification data.
- 4. Identify body styles.

#### C. Shop Operations (3 questions)

- 1. Manage work flow.
- 2. Demonstrate knowledge of sublet procedures.
- 3. Maintain customer appointment log.
- 4. Address repeat repairs/comebacks. ■

# Sample Questions Automobile Service Consultant (Test C1)

#### QUESTIONS:

- A customer requests that the timing be adjusted on their vehicle. The service consultant should:
  - (A) explain that ignition timing may not be adjustable
  - \* (B) ask the customer about their vehicle symptoms
    - (C) quote a price for the request
    - (D) suggest new spark plugs with the service.
- 2. A customer comes in for a 30,000 mile service. While completing the service, the technician notes that the vehicle will soon need the front brake pads replaced. Which of these is the best way to address this need with the customer?
  - (A) Note the technician's comments on the customer's repair order.
  - (B) Input the technician's comments in the dealership's database for review at the next service
  - \* (C) Call the customer and offer to complete the repair explaining why it is needed.
    - (D) Address the need when the customer arrives to pick up their vehicle.
- 3. Which of these functions is performed by the engine timing belt?
  - (A) It connects the pistons to the crankshaft
  - (B) It can be used to adjust spark timing
  - \* (C) It drives the camshaft.
    - (D) It controls engine RPM
- 4. A vehicle's "ABS" light remains on while driving.

Service Consultant A says that while the light is on, the ABS system will still function.

Service Consultant B says that while the light is on, the mechanical brake system will still function.

Who is right?

- (A) A only
- \* (B) B only
  - (C) Both A and B
  - (D) Neither A nor B

# C1 SAMPLE QUESTIONS (CONTINUED)

Service Consultant A says that maintenance schedules are most likely found in the extended warranty contract.

Service Consultant B says that maintenance schedules are based on time and mileage.

Who is right?

- (A) A only
- \* (B) B only
  - (C) Both A and B
  - (D) Neither A nor B
- 6. All of these are maintenance items EXCEPT a:
  - (A) Transmission flush
  - (B) 60 K service
  - \* (C) Water pump leak
    - (D) Tire rotation

# Specifications and Task List Compressed Natural Gas Vehicle (Test F1)

Content Area	Questions in Test	Percentage of Test	
A. Vehicle Inspection for Condition, Su and Compliance	uitability, 5	9.1%	
B. Equipment Suitability Installation	3	9.176	
and Inspection	8	14.5%	
C. Leak Testing and Repairs	6	10.9%	
D. Emissions, Performance Verification	n,		
and Adjustments	11	20.0%	
E. System Diagnosis, Maintenance, ar	nd Repair 16	29.1%	
F. General Cylinder Safety and Mainte	enance 9	16.4%	
Total	55	100%	

Note: All CNG vehicle conversion, testing, service, and repair should be performed using vehicle and component manufacturer's guidelines and current NFPA 52 and/or local safety standards.

#### A. Vehicle Inspection for Condition, Suitability and compliance (5 questions)

- Inspect vehicle for fitness (weight, mileage, applicable emissions standards, and safety standards).
- 2. Analyze engine performance; determine needed repairs.
- 3. Verify size, weight and capacity of compressed natural gas cylinder(s).
- Inspect for proper location and mounting of compressed natural gas cylinders and fuel system components.
- 5. Inspect for location, condition and compliance of venting system(s).

#### **B. Equipment Installation and Inspection (8 questions)**

- 1. Visually inspect fuel storage cylinders and system components prior to installation.
- Install fuel storage system; secure with recommended brackets, isolators, reinforcements, and fasteners; inspect fuel storage system.
- 3. Install/inspect regulator assembly(ies) and coolant lines as required.
- 4. Install/inspect underhood fuel delivery system components.
- 5. Install and connect/inspect system wiring.
- 6. Install/inspect electrical and electronic components.
- 7. Install/inspect instrument panel components.
- 8. Install / inspect fuel lines, clamps, filters, and fittings.

- Install / inspect valves, pressure relief devices, venting systems, lines and fittings; secure with recommended fasteners.
- 10. Install / inspect fuel fill receptacle(s) and check valve(s).
- 11. Install / inspect required labels.
- 12. Complete system documentation as required.

# C. Leak Testing and Repairs (6 questions)

- 1. Check for low and high-pressure natural gas leaks; repair as needed.
- 2. Pressurize cylinders with natural gas.
- 3. Check for coolant leaks; repair as needed.
- 4. Check venting system integrity as required.

#### D. Emissions, Performance Verification and Adjustments (11 questions)

- 1. Check base ignition timing; adjust where applicable.
- 2. Check regulator(s) pressure(s); adjust where applicable.
- 3. Check mixture settings; adjust where applicable
- 4. Verify Power Train Control Module(s) (PCM) Calibration.
- 5. Check operation of electronic components.
- 6. Check operation of fuel gauge; make repairs as required.
- 7. Perform emission tests; make repairs and document where applicable.
- 8. Road test vehicle for acceptable driveability; check starting/restarting abilities.
- 9. Check manual and automatic fuel changeover operation (bi-fuel vehicles).
- 10. Check fuel system for abnormal noises.
- 11. Verify gaseous fuel management operation.

# E. System Diagnosis Maintenance and Repair (16 questions)

Note: The following tasks apply to both bi-fuel and dedicated CNG vehicles.

- 1. Interpret and verify operational complaint; determine needed repair.
- 2. Visually inspect gaseous fuel system components; determine needed repairs.
- 3. Retrieve and interpret Diagnostic Trouble Codes (DTC) through the use of recommended PC based software, DMM, and/or scan tool.
- Diagnose driveability and emissions problems related to the ignition system; determine needed repairs.
- 5. Diagnose driveability and emissions problems related to fuel and air induction systems, and exhaust systems; determine needed repairs.
- Diagnose driveability and emissions problems related to electronic engine controls; determine needed repairs.
- 7. Check vacuum/electrical/electronic component operation; repair or replace as needed.
- Check gaseous fuel delivery system pressures, component operation; repair or replace as needed.
- Remove and/or replace fuel lines, manual and electrical valves, fittings, and pressure relief devices.
- 10. De-fuel CNG system.
- 11. Check for signs of fuel contamination; inspect, replace and/or service fuel system filters as required.

#### F. General Cylinder Safety and Maintenance (9 questions)

- 1. Visually inspect fuel storage cylinder(s), shields and mounting.
- 2. Remove and replace cylinders; de-fuel according to recommended procedures; replace shields, brackets, and hardware as required.
- 3. Handle and store cylinders in accordance with recommended procedures.
- 4. Interpret cylinder label information; determine necessary action.
- Inspect pressure relief devices (PRD) and related hardware; determine necessary action.
- Inspect condition and operation of cylinders / tank valves; determine necessary action.
- 7. Decommission cylinders according to recommended procedures.

# Sample Questions Compressed Natural Gas Vehicle (Test F1)

## QUESTIONS:

1.	With a bi-fuel vehicle running on CNG, the technician should set base ignition
	timing at:

\* (A) OEM specifications.

(C) 40 retarded.

(B) 2º retarded.

(D) 100 advanced.

2. Which of these should be used to check the fuel line connections after a compressed natural gas conversion?

(A) Nitrogen

\* (C) Non-ammonia soap

(B) Propane

(D) Carbon dioxide

3. Technician A says that a CNG refueling receptacle must be located in the engine compartment.

Technician B says that the refueling receptacle must have a different connection for each pressure-base system.

Who is right?

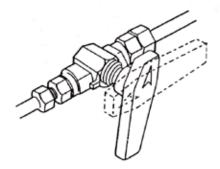
(A) Technician A

(C) Both A and B

\* (B) Technician B

(D) Neither A nor B

# F1 SAMPLE QUESTIONS (CONTINUED)



4. A vehicle with the valve shown above is in for a routine coalescent filter change

Technician A says that the valve should be closed to stop fuel flow to the engine.

Technician B says that the valve should be closed to stop fuel flow from the tank.

Who is right?

(A) Technician A

(C) Both A and B

\* (B) Technician B

(D) Neither A nor B

## Questions 5 is not like the ones above.

Each has the word **EXCEPT**. For each of these questions, look for the choice that could **NOT** cause the described situation. Read the entire question carefully before choosing your answer.

- A dedicated CNG vehicle has a no start condition. All of these could be the cause EXCEPT:
  - (A) no ignition source.
  - \* (B) recurved timing.
    - (C) no fuel pressure.
    - (D) low battery voltage.

# TEST SPECIFICATIONS AND TASK LIST EXHAUST SYSTEMS (TEST X1)

Content Area	Questions in Test	Percentage of Test
<ul><li>A. Exhaust System Inspection and Repair</li><li>1. Inspection (6)</li><li>2. Repair (5)</li></ul>	11	28%
B. Emissions Systems Diagnosis	8	20%
<ul><li>C. Exhaust System Fabrication</li><li>1. Pipe Bending (3)</li><li>2. Welding and Cutting (3)</li></ul>	6	15%
D. Exhaust System Installation	8	20%
E. Exhaust System Repair Regulations	7	18%
Total	40	100%

# A. Exhaust System Inspection and Repair (11 questions)

# 1. Inspection (6 questions)

- 1. Inspect all exhaust system components for noises, rattles, missing parts, configuration, and routing by visual, audible, and thump testing; determine needed repair.
- Inspect exhaust system for leaks, restrictions, and overheating by visual, audible, back pressure, vacuum, and temperature testing; determine needed repair.
- 3. Inspect exhaust subsystems [air injection reactor (AIR), exhaust gas recirculation (EGR), oxygen sensor(s) (O2S/HO2S), heat riser/early fuel evaporation (EFE), turbochargers] and mounting hardware; determine needed repair.
- 4. Visually inspect exhaust system for evidence of tampering (missing/modified and/or improperly installed components); determine needed repair.
- 5. Inspect exhaust system electrical components; determine needed repair.
- 6. Inspect engine/transmission mount condition and alignment; determine needed repair.

## 2. Repair (5 questions)

- 1. Repair or replace failed or damaged mufflers, pipes, and related components.
- 2. Repair or replace damaged catalytic converters.
- 3. Repair or replace exhaust manifolds.
- Repair or replace exhaust system mounting hardware and related installation components.
- Repair or replace exhaust subsystems [air injection reactor (AIR), exhaust gas recirculation (EGR), oxygen sensor (O2S/HO2S), heat riser/early fuel evaporation (EFE), turbochargers] and mounting hardware.

# X1 TASK LIST (CONTINUED)

# **B. Emissions Systems Diagnosis (8 questions)**

- Identify failed catalytic converter(s); determine cause of failure; determine needed repair.
- 2. Identify failed air injection reactor (AIR) system; determine root cause of failure; determine needed repair.
- 3. Identify failed exhaust gas recirculation (EGR) system; determine root cause of failure; determine needed repair.
- 4. Identify failed early fuel evaporation (EFE) system [heat riser]; determine root cause of failure; determine needed repair.
- 5. Identify failed oxygen sensor(s) (O2S/HO2S) component(s) and circuitry; determine cause of failure; determine needed repair.
- Inspect emission systems for evidence of tampering (missing/modified and/or improperly installed components); determine needed repair.

# **C. Exhaust System Fabrication (6 questions)**

# 1. Pipe Bending (3 questions)

- 1. Determine bending method (program card, pattern/copy, or custom).
- 2. Determine center of bends, rotation of pipe, depth of bends, and pipe diameter(s); perform bending operation.
- 3. Perform end-forming and hardware installation operations.
- 4. Determine the cause of pipe material failures that occur during bending operations.

# 2. Welding and Cutting (3 questions)

- Select appropriate welding method (gas or MIG); perform welding operation; verify integrity of weld.
- 2. Set up and adjust welding equipment to repair application; observe applicable personnel, vehicle, and equipment safety procedures.
- 3. Select appropriate cutting method (gas or mechanical); perform cutting operation.
- 4. Set up and adjust cutting equipment to repair application; observe applicable personnel, vehicle, and equipment safety procedures.

## **D. Exhaust System Installation (8 questions)**

- 1. Identify exhaust system configuration and options according to manufacturer's specifications (routing, single/dual, etc).
- Select components according to accepted standards regarding material, type, design, and size.
- 3. Install appropriate exhaust system components (mufflers, resonators, catalytic converters, pipes, and manifolds).
- Install appropriate exhaust system hardware (clamps, hangers, gaskets, flanges, fasteners, and heat shields).
- 5. Inspect system for proper exhaust component clearance and routing.
- 6. Inspect system for proper exhaust component-to-component connection sealing.
- 7. Install exhaust subsystem components [air injection reactor (AIR), exhaust gas recirculation (EGR) valve, oxygen sensor(s) (O2S/HO2S), early fuel evaporation (EFE) system (heat riser)].

# X1 TASK LIST (CONTINUED)

## E. Exhaust System Repair Regulations (7 questions)

Note: Federal EPA law establishes minimum compliance requirements for emission systems repair. States and local municipalities may institute requirements that exceed the Federal EPA requirements. Knowledge of the Federal EPA requirements will be addressed in the following tasks.

- Comply with warranty and diagnostic requirements regarding permissible catalytic converter installations.
- 2. Comply with requirements regarding prohibited catalytic converter installations.
- 3. Comply with requirements regarding record keeping.
- 4. Comply with requirements regarding catalytic converter replacement, location, and type.
- Comply with requirements regarding replacement of air injection reactor (AIR), exhaust gas recirculations (EGR), oxygen sensor (O2S/HO2S), heat riser [early fuel evaporation (EFE)], and turbocharger systems.
- 6. Comply with requirements regarding exhaust system configuration.

# Sample Questions Exhaust Systems (Test X1)

# QUESTIONS:

1.	Which of these will most likely	y cause an exhaust manifold gasket to fail?
	(A) A bad AIR pump	(C) An inoperative converter

\* (B) A restricted exhaust system

(D) A bad EGR valve

2. Which of these repairs should be made on a vehicle with a cracked converter flange?

- \* (A) Repair or replace the flange
  - (B) Replace the converter
  - (C) Replace the lead pipe
  - (D) Seal and clamp the connection
- A visual inspection of a vehicle's catalytic converter reveals that the substrate (brick) has melted.

Technician A says that a bad oxygen sensor (O2S) could be the cause.

Technician B says that a misfiring spark plug could be the cause.

Who is right?

(A) A only

\* (C) Both A and B

(B) B only

(D) Neither A nor B

4. To fit a  $2^{1/4}$ " (57 mm) diameter pipe to fit over another  $2^{1/4}$ " (57 mm) diameter pipe, a technician should expand the pipe to:

- (A) 2 3/8" (60 mm) OD.
- (B) 2 1/8" (54 mm) OD.
- (C) 2 1/2" (64 mm) ID.
- \* (D) 2 1/4" (57 mm) ID.

When performing a "converter-back" exhaust system installation, a technician should:

- (A) replace all hangers.
- \* (B) check for proper clearances.
  - (C) weld each connection.
  - (D) test for proper backpressure.

# X1 SAMPLE QUESTIONS (CONTINUED)

6. Technician A says that a broken transmission mount could cause the exhaust system to become misaligned.

Technician B says that a broken engine mount could cause the exhaust system to become misaligned.

Who is right?

(A) A only

\* (C) Both A and B

(B) B only

- (D) Neither A nor B
- 7. Which of these is an illegal procedure to perform on a catalytic converter equipped vehicle?
  - \* (A) Install a test pipe in place of the converter
    - (B) Install a muffler before the converter
    - (C) Install a converter bolted directly to the exhaust manifold
    - (D) Install a three-way converter in place of a two-way converter
- 8. The flex pipe, located between the exhaust manifold and the catalytic converter, is broken. A flex pipe should be used as a replacement because it:
  - (A) strengthens the exhaust systems.
  - (B) quiets the exhaust system.
  - (C) helps to heat the converter.
  - \* (D) allows for engine movement.

The following sources of information provide comprehensive listings of training resources available to working technicians:

# **Delmar Cengage Learning**

P.O. Box 6904 Florence, KY 41022 1-800-487-8488 www.autoed.cengage.com www.cengage.com/delmar

# **Motor Age Training for Certification**

131 West First Street Duluth, MN 55802 800-240-1968 www.motorage.com

In Canada

# **Thomson Learning Nelson Canada**

1120 Birchmount Road Scarborough, Ontario M1K 5G4 1-800-268-222 E-mail: inquire@nelson.com

#### **Spanish Language Training Resources**

For a listing of training providers who offer training, or training materials in Spanish go to www.ase.com; once there, enter the "Service Professionals" area and click on "Spanish Language Training Resources."

# **MD Publications**

Undercar Digest, July Issue Transmission Digest, September Issue P.O. Box 2210 Springfield, MO 65801 1-800-274-7890

### **Motor Source Guide**

Hearst Business Publishing, Inc. 645 Stewart Ave. Garden City, NY 11530 www.motor.com

# Fleet Equipment, April Issue

P.O. Box 7605 Mt. Prospect, IL 60056-7605 www.truklink.com

#### Recursos de Educación en Español

Para obtener acceso a la lista de proveedores de educación, ó materiales educativos en Español diríjase a www.ase.com; una ves allí, entre en la sección "Español" y prosiga al área "Lista de Educadores y Materiales Didácticos."

CASE: ASE Certification for Training Providers of Continuing Automotive Service Education. Visit www.natef.org/case/case\_certified.cfm for periodic updates to this list.

The National Institute for Automotive Service Excellence (ASE) and its educational foundation, the National Automotive Technicians Education Foundation (NATEF), offer a voluntary certification program for institutions and organizations providing continuing automotive service education. ASE seeks to improve the quality of continuing automotive education and help automotive technicians identify appropriate training sources and activities by evaluating and certifying providers of continuing automotive service education against CASE Standards.

The CASE program differs from ASE's existing entry-level training program certification in that it addresses the training provider's process of developing and delivering training as opposed to prescribing specific program content. Elements of organization, structure and methods which appear to contribute significantly to the development and delivery of high quality automotive service education, have been identified and incorporated into the CASE Standards.

The following training providers have achieved CASE certification. Please note that \* indicates a proprietary program unavailable to all technicians.

# 3M Industrial and Transportation Business Services Training and Development

3M Center Building 225-1N-01 St. Paul, MN 55144 651-737-0141 www.3m.com/automotive

# **ACDelco Service Training**

6200 Grand Point Dr., MC#2-316 Grand Blanc, MI 48439 800-825-5886 prompt 1 www.acdelcotechconnect.com

# **Affinia Under Vehicle Group**

Technical Services Department 4400 Prime Parkway McHenry, IL 60050 815- 363-9000 – ask for technical www.raybestos.com

# AKZO NOBEL Coatings Inc., Car Refinishes

5555 Spalding Dr. Norcross, GA 30092 770-242-5760 www.akzonobelcarrefinishes.net

# **American Automobile Association, Inc.**

1000 AAA Dr.
Heathrow, FL 32746
407-444-7169 or 407-444-8041
Allan Stanley, astanley@national.aaa.com
Len Johannes, ljohannes@national.aaa.com
www.aaa.com

# \*American Honda Automobile Service Training

1919 Torrance Blvd. Torrance, CA 90501 310-783-3557 www.honda.com

# Automotive Spray Equipment Technologies (ASET)

3703 West Parkway Blvd. Salt Lake City, UT 84120 801-964-6646 www.asetusa.com

# **ATech Training, Inc**

12290 Chandler Dr. PO Box 297 Walton, KY 41094 859-485-7229 ext. 109 www.atechtraining.com

## **BASF Automotive Refinish Division**

26701 Telegraph Rd. Southfield, MI 48034 248-304-5200 www.basfrefinish.com

# **BP Global Fuels Technology**

150 W. Warrenville Rd. 800 Building Naperville, IL 60563 312-729-4212 www.fuelcertification.com

# **Chief Automotive Systems**

996 Industrial Dr. Madison, IN 47250 800-445-9262 www.chiefautomotive.com

#### **CAROUEST Technical Institute**

4401 Atlantic Ave. Raliegh, NC 27604 919-573-3000 www.CARQUEST.com/CTI

# **Collision Management Services Inc.** 2040R Lord Baltimore Dr.

Baltimore, MD 21244 410-944-3383 www.ineedcms.com/Training.html

# **Delphi Integrated Service Solutions**

5820 Delphi Dr. Troy, MI 48098 800-545-2220 Customer Support www.delphi-iss.com

# **DuPont Performance Coatings**

500 Eagleview Blvd. Exton, PA 19341 610-458-6323 www.pc.dupont.com

## **EAST Training Inc.**

4404 Sylon Blvd. Hainesport, NJ 08036 609-267-2223 www.easttraining.com

## Federal Mogul Technical Education Centers

6565 Wells Ave. St. Louis, MO 63133 314-977-0684 www.federal-mogul.com

## **Fox Valley Technical College**

1825 N. Bluemound Dr. Appleton, WI 54912 920-993-5163 www.fvtc.edu/public

# \*General Motors Service Technical College

30501 Van Dyke Ave., M/C 480-204-100 Warren, MI 48090 586-947-9704 www.gmstc.com

# **Hunter Engineering**

11250 Hunter Dr. Bridgeton, MO 63044 314-731-0000 www.hunter.com

# I-CAR (Inter-Industry Conference on Auto Collision Repair)

5125 Trillium Blvd. Hoffman Estates, IL 60192 800-422-7872 www.i-car.com

#### **Iwata Medea**

3703 West Parkway Blvd. West Valley City, UT 87120 801-964-6646 www.asetusa.com

#### **Jiffy Lube International**

700 Milam, Room 24038PNT Houston, TX 77002 713-546-3957 www.jiffylube.com

#### **Kent Automotive**

6200 Oak Tree Blvd., #350 Independence, OH 44131 216-642-5973 www.kent-automotive.com

# **Lawson State Community College**

1100 9th Ave., SW Bessemer, AL 35022 205-929-3521 www.lawsonstate.edu

# Lew Kinney & Associates On-site Welding Training and Certifications

PO Box 511, 184 State Route 314 Centerburg, OH 43011 740-625-6342

# \*Lexus, A Division of Toyota Motor Sales, Inc., U.S.A.

19001 S. Western Ave. Torrance, CA 90509 Technical Training 310-468-4958 www.lexus.com

# **Martin Senour Automotive Finishes**

7019 Highgrove Rd. Burr Ridge, IL 60527 630-887-7516 www.martinsenour-autopaint.com

# **Megatech Corporation**

525 Woburn St., Suite 3 Tewksbury, MA 01876 800-767-6342 (US) 978-937-9600 (Int'1) www.megatechcorp.com

## Melior, Inc.

200 Cahaba Park Circle West, Suite 250 Birmingham, AL 35242 205-298-8300 www.melioronline.com

# National Automotive Parts Association (NAPA)

2999 Circle 75 Pkwy. Atlanta, GA 30339 800-292-NIAT (6428) www.niat-training.com

# **National Appraisal Institute**

10150 Canoga Ave Chatsworth, CA 91311 818-775-1370 www.nainstitute.com

## **Nationwide Training Organization**

9243 Columbus Pike Lewis Center, OH 43035 614-840-7169 www.nationwide.com

## \*Navistar, Inc.

3033 Wayne Terrace Fort Wayne, IN 46806 260-461-1951 www.navistar.com

# \*Nissan North America, Inc. Customer Loyalty and Training

P.O. Box 685001 Franklin, TN 37068 615- 725-8319 www.nissantechinfo.com

# \*Penske Truck Leasing

Route 10 Pheasant Rd., PO Box 563 Reading, PA 19607 610-775-6479 www.gopenske.com

#### **PPG Industries**

19699 Progress Dr. Strongsville, OH 44149 440-572-6784 www.ppg.com

# **Raytheon Professional Services L.L.C.**

1919 Technology Dr. Troy, MI 48083 248-837-6777 www.rps.com

#### **Saint Gobain Abrasives**

1 New Bond St. Worcester, MA 01606 508-795-2774 www.nortonautomotive.com www.aa.carborundumabrasives.com

## **SEM Products. Inc.**

1685 Overview Dr. Rock Hill, SC 29730 803-207-8231 www.semproducts.com

# Sherwin-Williams Automotive Finishes Corp.

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