Delmar's Test Preparation Series

Automobile Test

Brakes (Test A5)

2nd Edition

DELMAR
THOMSON LEARNING
Australia Canada Mexico Singapore Spain United Kingdom United States

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For more information contact Delmar,
3 Columbia Circle, PO Box 15015,
Albany, NY 12212-5015.

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Contents

Section 5 Sample Test for Practice

Section 6 Additional Test Questions for Practice

Section 7 Appendices

Preface

This book is just one of a comprehensive series designed to prepare technicians to take and pass every ASE test. Delmar's series covers all of the Automotive tests A1 through A8 as well as Advanced Engine Performance L1 and Parts Specialist P2. The series also covers the five Collision Repair tests and the eight Medium/Heavy Duty truck tests.

Before any book in this series was written, Delmar staff met with and surveyed technicians and shop owners who have taken ASE tests and have used other preparatory materials. We found that they wanted, first and foremost, *lots* of practice tests and questions. Each book in our series contains a sample test and additional practice questions. You will be hard-pressed to find a test prep book with more questions for you to practice with. We have worked hard to ensure that these questions match the ASE style in types of questions, quantities, and level of difficulty.

Technicians also told us that they wanted to understand the ASE test and to have practical information about what they should expect. We have provided that as well, including a history of ASE and a section devoted to helping the technician "Take and Pass Every ASE Test" with case studies, test-taking strategies, and test formats.

Finally, techs wanted refresher information and references. Each of our books includes an overview section that is referenced to the task list. The complete task lists for each test appear in each book for the user's reference. There is also a complete glossary of terms for each booklet.

So whether you're looking for a sample test and a few extra questions to practice with or a complete introduction to ASE testing, with support for preparing thoroughly, this book series is an excellent answer.

We hope you benefit from this book and that you pass every ASE test you take!

Your comments, both positive and negative, are certainly encouraged! Please contact us at:

Automotive Editor
Delmar Publishers
3 Columbia Circle
Box 15015
Albany, NY 12212-5015

1 The History of ASE

History

Originally known as The National Institute for Automotive Service Excellence (NIASE), today's ASE was founded in 1972 as a non-profit, independent entity dedicated to improving the quality of automotive service and repair through the voluntary testing and certification of automotive technicians. Until that time, consumers had no way of distinguishing between competent and incompetent automotive mechanics. In the mid-1960s and early 1970s, efforts were made by several automotive industry affiliated associations to respond to this need. Though the associations were non-profit, many regarded certification test fees merely as a means of raising additional operating capital. Also, some associations, having a vested interest, produced test scores heavily weighted in the favor of its members.

From these efforts a new independent, non-profit association, the National Institute for Automotive Service Excellence (NIASE), was established. In early NIASE tests, Mechanic A, Mechanic B type questions were used. Over the years the trend has not changed, but in mid-1984 the term was changed to Technician A, Technician B to better emphasize sophistication of the skills needed to perform successfully in the modern motor vehicle industry. In certain tests the term used is Estimator A/B, Painter A/B, or Parts Specialist A/B. At about that same time, the logo was changed from "The Gear" to "The Blue Seal," and the organization adopted the acronym ASE for Automotive Service Excellence.

ASE

ASE's mission is to improve the quality of vehicle repair and service in the United States through the testing and certification of automotive repair technicians. Prospective candidates register for and take one or more of ASE's many exams.

Upon passing at least one exam and providing proof of two years of related work experience, the technician becomes ASE certified. A technician who passes a series of exams earns ASE Master Technician status. An automobile technician, for example, must pass eight exams for this recognition.

The exams, conducted twice a year at over seven hundred locations around the country, are administered by American College Testing (ACT). They stress real-world diagnostic and repair problems. Though a good knowledge of theory is helpful to the technician in answering many of the questions, there are no questions specifically on theory. Certification is valid for five years. To retain certification, the technician must be retested to renew his or her certificate.

The automotive consumer benefits because ASE certification is a valuable yardstick by which to measure the knowledge and skills of individual technicians, as well as their commitment to their chosen profession. It is also a tribute to the repair facility employing ASE certified technicians. ASE certified technicians are permitted to wear blue and white ASE shoulder insignia, referred to as the "Blue Seal of Excellence," and carry credentials

listing their areas of expertise. Often employers display their technicians' credentials in the customer waiting area. Customers look for facilities that display ASE's Blue Seal of Excellence logo on outdoor signs, in the customer waiting area, in the telephone book (Yellow Pages), and in newspaper advertisements.

To become ASE certified, contact:

National Institute for Automotive Service Excellence
13505 Dulles Technology Drive
Herndon, VA 20171-3421

2 Take and Pass Every ASE Test

ASE Testing

Participating in an Automotive Service Excellence (ASE) voluntary certification program gives you a chance to show your customers that you have the "know-how" needed to work on today's modern vehicles. The ASE certification tests allow you to compare your skills and knowledge to the automotive service industry's standards for each specialty area.

If you are the "average" automotive technician taking this test, you are in your mid-thirties and have not attended school for about fifteen years. That means you probably have not taken a test in many years. Some of you, on the other hand, have attended college or taken postsecondary education courses and may be more familiar with taking tests and with test-taking strategies. There is, however, a difference in the ASE test you are preparing to take and the educational tests you may be accustomed to.

Who Writes the Questions?

The questions on all ASE tests are written by service industry experts familiar with all aspects of the subject area. ASE questions are entirely job-related and designed to test the skills that you need to know on the job.

The questions originate in an ASE "item-writing" workshop where service representatives from domestic and import automobile manufacturers, parts and equipment manufacturers, and vocational educators meet in a workshop setting to share their ideas and translate them into test questions. Each test question written by these experts is reviewed by all of the members of the group.

All of the questions are pretested and quality-checked in a nonscoring section of tests by a national sample of certifying technicians. The questions that meet ASE's high standards of accuracy and quality are then included in the scoring sections of future tests. Those questions that do not pass ASE's stringent test are sent back to the workshop or are discarded. ASE's tests are monitored by an independent proctor and are administered and machine-scored by an independent provider, American College Testing (ACT).

Objective Tests

A test is called an objective test if the same standards and conditions apply to everyone taking the test and there is only one correct answer to each question. Objective tests primarily measure your ability to recall information. A well-designed objective test can also test your ability to understand, analyze, interpret, and apply your knowledge. Objective tests include true-false, multiple choice, fill in the blank, and matching questions. ASE's tests consist exclusively of four-part multiple-choice objective questions.

Before beginning to take an objective test, quickly look over the test to determine the number of questions, but do not try to read through all of the questions. In an ASE test, there are usually between forty and eighty questions, depending on the subject. Read through each question before marking your answer. Answer the questions in the order they appear on the test. Leave the questions blank that you are not sure of and move on to the next question. You can return to those unanswered questions after you have finished the others. They may be easier to answer at a later time after your mind has had additional time to consider them on a subconscious level. In addition, you might find information in other questions that will help you to answer some of them.

Do not be obsessed by the apparent pattern of responses. For example, do not be influenced by a pattern like **d, c, b, a, d, c, b, a** on an ASE test.

There is also a lot of folk wisdom about taking objective tests. For example, there are those who would advise you to avoid response options that use certain words such as *all, none, always, never, must,* and *only,* to name a few. This, they claim, is because nothing in life is exclusive. They would advise you to choose response options that use words that allow for some exception, such as *sometimes, frequently, rarely, often, usually, seldom,* and *normally.* They would also advise you to avoid the first and last option (A and D) because test writers, they feel, are more comfortable if they put the correct answer in the middle (B and C) of the choices. Another recommendation often offered is to select the option that is either shorter or longer than the other three choices because it is more likely to be correct. Some would advise you to never change an answer since your first intuition is usually correct.

Although there may be a grain of truth in this folk wisdom, ASE test writers try to avoid them and so should you. There are just as many **A** answers as there are **B** answers, just as many **D** answers as **C** answers. As a matter of fact, ASE tries to balance the answers at about 25 percent per choice **A, B, C,** and **D.** There is no intention to use "tricky" words, such as outlined above. Put no credence in the opposing words "sometimes" and "never," for example.

Multiple-choice tests are sometimes challenging because there are often several choices that may seem possible, and it may be difficult to decide on the correct choice. The best strategy, in this case, is to first determine the correct answer before looking at the options. If you see the answer you decided on, you should still examine the options to make sure that none seem more correct than yours. If you do not know or are not sure of the answer, read each option very carefully and try to eliminate those options that you know to be wrong. That way, you can often arrive at the correct choice through a process of elimination.

If you have gone through all of the test and you still do not know the answer to some of the questions, then guess. Yes, guess. You then have at least a 25 percent chance of being correct. If you leave the question blank, you have no chance. In ASE tests, there is no penalty for being wrong.

Preparing for the Exam

The main reason we have included so many sample and practice questions in this guide is, simply, to help you learn what you know and what you don't know. We recommend that you work your way through each question in this book. Before doing this, carefully look through Section 3; it contains a description and explanation of the questions you'll find in an ASE exam.

Once you know what the questions will look like, move to the sample test. After you have answered one of the sample questions (Section 5), read the explanation (Section 7) to the answer for that question. If you don't feel you understand the reasoning for the correct answer, go back and read the overview (Section 4) for the task that is related to

that question. If you still don't feel you have a solid understanding of the material, identify a good source of information on the topic, such as a textbook, and do some more studying.

After you have completed the sample test, move to the additional questions (Section 6). This time answer the questions as if you were taking an actual test. Once you have answered all of the questions, grade your results using the answer key in Section 7. For every question that you gave a wrong answer to, study the explanations to the answers and/or the overview of the related task areas.

Here are some basic guidelines to follow while preparing for the exam:

- Focus your studies on those areas you are weak in.
- Be honest with yourself while determining if you understand something.
- Study often but in short periods of time.
- Remove yourself from all distractions while studying.
- Keep in mind the goal of studying is not just to pass the exam, the real goal is to learn!

During the Test

Mark your bubble sheet clearly and accurately. One of the biggest problems an adult faces in test-taking, it seems, is in placing an answer in the correct spot on a bubble sheet. Make certain that you mark your answer for, say, question 21, in the space on the bubble sheet designated for the answer for question 21. A correct response in the wrong bubble will probably be wrong. Remember, the answer sheet is machine scored and can only "read" what you have bubbled in. Also, do not bubble in two answers for the same question.

If you finish answering all of the questions on a test ahead of time, go back and review the answers of those questions that you were not sure of. You can often catch careless errors by using the remaining time to review your answers.

At practically every test, some technicians will invariably finish ahead of time and turn their papers in long before the final call. Do not let them distract or intimidate you. Either they knew too little and could not finish the test, or they were very self-confident and thought they knew it all. Perhaps they were trying to impress the proctor or other technicians about how much they know. Often you may hear them later talking about the information they knew all the while but forgot to respond on their answer sheet.

It is not wise to use less than the total amount of time that you are allotted for a test. If there are any doubts, take the time for review. Any product can usually be made better with some additional effort. A test is no exception. It is not necessary to turn in your test paper until you are told to do so.

Your Test Results!

You can gain a better perspective about tests if you know and understand how they are scored. ASE's tests are scored by American College Testing (ACT), a non-partial, non-biased organization having no vested interest in ASE or in the automotive industry. Each question carries the same weight as any other question. For example, if there are fifty questions, each is worth 2 percent of the total score. The passing grade is 70 percent. That means you must correctly answer thirty-five of the fifty questions to pass the test.

The test results can tell you:

- where your knowledge equals or exceeds that needed for competent performance, or
- where you might need more preparation.

The test results *cannot* tell you:

- how you compare with other technicians, or
- how many questions you answered correctly.

Your ASE test score report will show the number of correct answers you got in each of the content areas. These numbers provide information about your performance in each area of the test. However, because there may be a different number of questions in each area of the test, a high percentage of correct answers in an area with few questions may not offset a low percentage in an area with many questions.

It may be noted that one does not "fail" an ASE test. The technician who does not pass is simply told "More Preparation Needed." Though large differences in percentages may indicate problem areas, it is important to consider how many questions were asked in each area. Since each test evaluates all phases of the work involved in a service specialty, you should be prepared in each area. A low score in one area could keep you from passing an entire test.

There is no such thing as average. You cannot determine your overall test score by adding the percentages given for each task area and dividing by the number of areas. It doesn't work that way because there generally are not the same number of questions in each task area. A task area with twenty questions, for example, counts more toward your total score than a task area with ten questions.

Your test report should give you a good picture of your results and a better understanding of your task areas of strength and weakness.

If you fail to pass the test, you may take it again at any time it is scheduled to be administered. You are the only one who will receive your test score. Test scores will not be given over the telephone by ASE nor will they be released to anyone without your written permission.

3 Types of Questions on an ASE Exam

ASE certification tests are often thought of as being tricky. They may seem to be tricky if you do not completely understand what is being asked. The following examples will help you recognize certain types of ASE questions and avoid common errors.

Each test is made up of forty to eighty multiple-choice questions. Multiple-choice questions are an efficient way to test knowledge. To answer them correctly, you must think about each choice as a possibility, and then choose the one that best answers the question. To do this, read each word of the question carefully. Do not assume you know what the question is about until you have finished reading it.

About 10 percent of the questions on an actual ASE exam will use an illustration. These drawings contain the information needed to correctly answer the question. The illustration must be studied carefully before attempting to answer the question. Often, techs look at the possible answers then try to match up the answers with the drawing. Always do the opposite; match the drawing to the answers. When the illustration is showing an electrical schematic or another system in detail, look over the system and try to figure out how the system works before you look at the question and the possible answers.

Multiple-Choice Questions

One type of multiple-choice question has three wrong answers and one correct answer. The wrong answers, however, may be almost correct, so be careful not to jump at the first answer that seems to be correct. If all the answers seem to be correct, choose the answer that is the most correct. If you readily know the answer, this kind of question does not present a problem. If you are unsure of the answer, analyze the question and the answers. For example:

A rocker panel is a structural member of which vehicle construction type?

A. Front-wheel drive
B. Pickup truck
C. Unibody
D. Full-frame

Analysis:

This question asks for a specific answer. By carefully reading the question, you will find that it asks for a construction type that uses the rocker panel as a structural part of the vehicle.

Answer A is wrong. Front-wheel drive is not a vehicle construction type.

Answer B is wrong. A pickup truck is not a type of vehicle construction.

Answer C is correct. Unibody design creates structural integrity by welding parts together, such as the rocker panels, but does not require exterior cosmetic panels installed for full strength.

Answer D is wrong. Full-frame describes a body-over-frame construction type that relies on the frame assembly for structural integrity.

Therefore, the correct answer is C. If the question was read quickly and the words "construction type" were passed over, answer A may have been selected.

EXCEPT Questions

Another type of question used on ASE tests has answers that are all correct except one. The correct answer for this type of question is the answer that is wrong. The word "EXCEPT" will always be in capital letters. You must identify which of the choices is the wrong answer. If you read quickly through the question, you may overlook what the question is asking and answer the question with the first correct statement. This will make your answer wrong. An example of this type of question and the analysis is as follows:

All of the following are tools for the analysis of structural damage EXCEPT:

A. height gauge.
B. tape measure.
C. dial indicator.
D. tram gauge.

Analysis:

The question really requires you to identify the tool that is not used for analyzing structural damage. All tools given in the choices are used for analyzing structural damage except one. This question presents two basic problems for the test-taker who reads through the question too quickly. It may be possible to read over the word "EXCEPT" in the question or not think about which type of damage analysis would use answer C. In either case, the correct answer may not be selected. To correctly answer this question, you should know what tools are used for the analysis of structural damage. If you cannot immediately recognize the incorrect tool, you should be able to identify it by analyzing the other choices.
Answer A is wrong. A height gauge *may* be used to analyze structural damage.
Answer B is wrong. A tape measure may be used to analyze structural damage.
Answer C is correct. A dial indicator may be used as a damage analysis tool for moving parts, such as wheels, wheel hubs, and axle shafts, but would not be used to measure structural damage.
Answer D is wrong. A tram gauge *is* used to measure structural damage.

Technician A, Technician B Questions

The type of question that is most popularly associated with an ASE test is the "Technician A says. . . Technician B says. . . Who is right?" type. In this type of question, you must identify the correct statement or statements. To answer this type of question correctly, you must carefully read each technician's statement and judge it on its own merit to determine if the statement is true.

Typically, this type of question begins with a statement about some analysis or repair procedure. This is followed by two statements about the cause of the problem, proper inspection, identification, or repair choices. You are asked whether the first statement, the second statement, both statements, or neither statement is correct. Analyzing this type of question is a little easier than the other types because there are only two ideas to consider although there are still four choices for an answer.

Technician A, Technician B questions are really double true or false questions. The best way to analyze this kind of question is to consider each technician's statement separately. Ask yourself, is A true or false? Is B true or false? Then select your answer from the four choices. An important point to remember is that an ASE Technician A, Technician B question will never have Technician A and B directly disagreeing with each other. That is why you must evaluate each statement independently. An example of this type of question and the analysis of it follows.

Structural dimensions are being measured. Technician A says comparing measurements from one side to the other is enough to determine the damage. Technician

B says a tram gauge can be used when a tape measure cannot measure in a straight line from point to point. Who is right?

A. A only
B. B only
C. Both A and B
D. Neither A nor B

Analysis:

With some vehicles built asymmetrically, side-to-side measurements are not always equal. The manufacturer's specifications need to be verified with a dimension chart before reaching any conclusions about the structural damage.

Answer A is wrong. Technician A's statement is wrong. A tram gauge would provide a point-to-point measurement when a part, such as a strut tower or air cleaner, interrupts a direct line between the points.

Answer B is correct. Technician B is correct. A tram gauge can be used when a tape measure cannot be used to measure in a straight line from point to point.

Answer C is wrong. Since Technician A is not correct, C cannot be the correct answer.

Answer D is wrong. Since Technician B is correct, D cannot be the correct answer.

Most-Likely Questions

Most-likely questions are somewhat difficult because only one choice is correct while the other three choices are nearly correct. An example of a most-likely-cause question is as follows:

The most likely cause of reduced turbocharger boost pressure may be a:

A. westgate valve stuck closed.
B. westgate valve stuck open.
C. leaking westgate diaphragm.
D. disconnected westgate linkage.

Analysis:

Answer A is wrong. A westgate valve stuck closed increases turbocharger boost pressure.

Answer B is correct. A westgate valve stuck open decreases turbocharger boost pressure.

Answer C is wrong. A leaking westgate valve diaphragm increases turbocharger boost pressure.

Answer D is wrong. A disconnected westgate valve linkage will increase turbocharger boost pressure.

LEAST-Likely Questions

Notice that in most-likely questions there is no capitalization. This is not so with LEAST-likely type questions. For this type of question, look for the choice that would be the least likely cause of the described situation. Read the entire question carefully before choosing your answer. An example is as follows:

What is the LEAST likely cause of a bent pushrod?

A. Excessive engine speed
B. A sticking valve
C. Excessive valve guide clearance
D. A worn rocker arm stud

Analysis:
Answer A is wrong. Excessive engine speed may cause a bent pushrod.
Answer B is wrong. A sticking valve may cause a bent pushrod.
Answer C is correct. Excessive valve clearance will not generally cause a bent pushrod.
Answer D is wrong. A worn rocker arm stud may cause a bent pushrod.

Summary

There are no four-part multiple-choice ASE questions having "none of the above" or "all of the above" choices. ASE does not use other types of questions, such as fill-in-the-blank, completion, true-false, word-matching, or essay. ASE does not require you to draw diagrams or sketches. If a formula or chart is required to answer a question, it is provided for you. There are no ASE questions that require you to use a pocket calculator.

Testing Time Length

An ASE test session is four hours and fifteen minutes. You may attempt from one to a maximum of four tests in one session. It is recommended, however, that no more than a total of 225 questions be attempted at any test session. This will allow for just over one minute for each question.

Visitors are not permitted at any time. If you wish to leave the test room, for any reason, you must first ask permission. If you finish your test early and wish to leave, you are permitted to do so only during specified dismissal periods.

You should monitor your progress and set an arbitrary limit to how much time you will need for each question. This should be based on the number of questions you are attempting. It is suggested that you wear a watch because some facilities may not have a clock visible to all areas of the room.

4 An Overview of the System

Brakes (Test A5)

The following section includes the task areas and task lists for this test and a written overview of the topics covered in the test.

The task list describes the actual work you should be able to do as a technician that you will be tested on by the ASE. This is your key to the test and you should review this section carefully. We have based our sample test and additional questions upon these tasks, and the overview section will also support your understanding of the task list. ASE advises that the questions on the test may not equal the number of tasks listed; the task lists tell you what ASE expects you to know how to do and be ready to be tested upon.

At the end of each question in the Sample Test and Additional Test Questions sections, a letter and number will be used as a reference back to this section for additional study. Note the following example: **B.5.**

Task List

B. Drum Brake Diagnosis and Repair (6 Questions)

Task B.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.**

Example:

1. While discussing brake backing plates, Technician A says a bent backing plate may cause brake grabbing. Technician B says a loose anchor bolt may cause brake chatter. Who is right?
   A. A only
   B. B only
   C. Both A and B
   D. Neither A nor B (B.5)

Question #1

Answer A is wrong.
Answer B is wrong.
Answer C is correct.
Answer D is wrong

Task List and Overview

A. Hydraulic System Diagnosis and Repair (14 Questions)

1. Master Cylinder (non-ABS) (3 Questions)

Task A.1.1 **Diagnose poor stopping or dragging caused by problems in the master cylinder; determine needed repairs.**

Dragging may be caused by swollen master cylinder cups or the compensation port covered in the master cylinder. This problem also may be caused by reduced brake pedal free play or improper adjustment of the stoplight and cruise control switch. If brake dragging occurs only on one front caliper, the quick take-up valve may not be allowing fluid movement from the reservoir into the primary piston area. Excessive pedal effort may be caused by swollen master cylinder cups or a corroded master cylinder.

Brake fluid leaking past the master cylinder cups may cause the brake pedal to slowly move downward during a brake application. An improperly adjusted stoplight and cruise control switch may keep the brake pedal partially depressed, resulting in brake drag.

Task A.1.2 **Diagnose poor stopping, dragging, high or low pedal, or hard pedal caused by problems in the step bore master cylinder and internal valves (e.g., volume control devices, quick take-up valve, fast-fill valve, pressure regulating valve); determine needed repairs.**

A low, spongy brake pedal may be caused by air in the hydraulic system or a low brake fluid level in the master cylinder. If the brake drums are machined so they are thinner than specified by the manufacturer, the brake pedal may be low and spongy. Weak brake hoses that expand under pressure may also cause a low, spongy brake pedal.

A hard brake pedal may be caused by contaminated brake fluid, swollen master cylinder cups, or a plugged quick take-up valve. Glazed brake linings or a defective brake booster also increase pedal effort.

A binding pedal linkage may cause improper pedal return and brake drag. Dented brake lines may cause pull to one side and brake drag.

Several car manufacturers use a dual master cylinder with two different sizes of cylinder bores. These are called step-bore cylinders. A step-bore master cylinder can be identified by the bulge or larger step diameter in the outside of the master cylinder casting.

The step-bore master cylinder uses a larger size bore for the rear of the primary piston than the front of the primary piston. The purpose of the larger bore is to improve the braking effectiveness with a shorter piston stroke.

This master cylinder also uses another component called a fast-fill valve, located between the primary piston and the reservoir. It consists of a spring-loaded ball and seal assembly. Its purpose is to rapidly fill the spool area of the primary piston with fluid from the reservoir.

Task A.1.3 **Measure and adjust master cylinder pushrod length.**

The specified brake pedal free play is usually 1/16 to 1/4 inch (1.6 to 6.4 mm). Excessive brake pedal free play causes a low brake pedal. When the brake pedal free play is less than specified, the compensating ports in the master cylinder may be closed by the piston cups when the brake pedal is released. This action results in fluid pressure buildup and dragging brakes.

During factory assembly, the pushrod is matched to the booster. It is normally adjusted only when the vacuum booster unit or the master cylinder is serviced.

Task A.1.4 Check master cylinder for defects by depressing brake pedal; determine needed repairs.

When the brake pedal moves downward slowly during a brake application, the brake fluid may be leaking past the master cylinder cups, or there may be a leak in a brake hose or line.

A small ripple or geyser may be seen in the reservoirs as the brakes are being applied. If no turbulence is seen, the bolts securing the master cylinder to the vacuum booster must be loosened 1/4 inch and the master cylinder must be pulled forward. The small ripple or geyser should be seen when the brakes are being applied at this time. If turbulence were to occur at this time, the brake pedal pushrod length must be adjusted. If the turbulence is not seen, the master cylinder is in need of replacement.

A spongy pedal may be caused by air in the hydraulic system. If the brake pedal slowly moves downward, fluid may be leaking past the master cylinder piston cups.

Task A.1.5 Diagnose cause of master cylinder external fluid leakage.

If there is an indication of paint removal and fluid leakage on the brake booster below the master cylinder, the secondary cup on the primary piston is leaking. If this leakage is present, there probably will be brake fluid in the brake booster when the master cylinder is removed. Use a suction gun to remove this fluid.

A slight dampness in the area surrounding the master cylinder is considered normal and is usually no reason for concern. The brake fluid level should be checked any time brake fluid is found external to the brake system. If any external fluid is detected, the entire system should be checked for leaks in areas other than the master cylinder.

Task A.1.6 Remove master cylinder from vehicle; install master cylinder; test operation of hydraulic system.

Plugging the end of the brake lines as they are removed prevents dirt and moisture from entering the brake lines and fluid. Disconnecting all (if any) electrical connectors from the master cylinder should be done prior to removing the master cylinder mounting hardware. However, it is not necessary to drain the master cylinder. By leaving the cap on and plugging the ports, there should be minimal leakage during removal.

Before removing the master cylinder in some vehicles, the proportioning valve assembly must be slid off the master cylinder mounting studs. In some vehicles, the vacuum valve from the booster must be removed and the pressure warning switch connector must be disconnected before lifting off the master cylinder. In vehicles that have manual (non-power) brake system master cylinders, the pushrod must be disconnected from the brake pedal before the master cylinder can be removed.

Bench bleeding removes all air from the master cylinder only. After a new or rebuilt master cylinder is installed on the vehicle, the entire system must be bled to remove all remaining air from the lines. It is important to use proper bleeding methods and to follow the correct bleeding sequence.

Task A.1.7 Bench bleed (check for function and remove air) all non-ABS master cylinders.

Bench bleeding removes all air from the fluid in the master cylinder only. After the new or rebuilt master cylinder is installed on the vehicle, the entire hydraulic system must be bled to remove all remaining air from the lines. It is important to use proper bleeding methods and to follow the correct bleeding sequence.

Bench bleeding involves mounting the master cylinder in a vise and forcing all of the air out of the unit. The most popular method involves installing lengths of tubing to the cylinder ports and feeding them back into the reservoir. The cylinder pistons are manually pumped to recirculate fluid back to the reservoir in a closed loop until all air bubbles to the surface.

2. Fluids, Lines, and Hoses (3 Questions)

Task A.2.1 Diagnose poor stopping, pulling, or dragging caused by problems in the brake fluid, lines, and hoses; determine needed repairs.

The most common causes of brake pull are seized caliper or wheel cylinder pistons, contaminated brake linings, scored or burned drums or rotors, and worn suspension components. If one front caliper is seized, the vehicle pulls to the opposite side of the seized caliper. When the brake linings are contaminated on a front wheel, the brake grabs on the wheel with the contaminated linings.

Task A.2.2 Inspect brake lines and fittings for leaks, dents, kinks, rust, cracks, or wear; tighten loose fittings and supports.

Brake lines should be inspected for leaks, cracks, rust, kinks, flattened areas, and splits. Damaged brake lines should be replaced rather than repaired. A tube-bending tool should be used to complete the necessary brake line bends.

The threaded parts used to connect brake hoses and tubing together and to other brake components are called fittings. Fittings are made from steel, so they can withstand the brake system pressures. Fittings are typically threaded to allow connection to other brake parts. Fittings are available in both U.S. (English) and metric threads. Threads from one system do not fit threads of the other system. Flats are formed on the fitting so that a wrench can be used in removing and installing them. Since the fitting on the end of steel brake tubing seals against a flare, this fitting is called a flare nut.

International Standards Organization (ISO) flare nuts cannot be mixed with double flare nuts; doing so can cause fluid leakage. Flare nuts do not corrode or rust, but this may occur on the tubing that passes through them.

Task A.2.3 Inspect flexible brake hoses for leaks, kinks, cracks, bulging, or wear; tighten loose fittings and supports.

Flexible brake hoses allow for movement between the suspension and the chassis. These hoses should be inspected for cracks, leaks, twists, bulges, loose supports, and internal restrictions. Each time a brake hose is removed, the sealing washer on the male end should be replaced. When a brake hose is installed, always install and tighten the male end first.

Task A.2.4 Fabricate and/or replace brake lines (double flare and ISO types), hoses, fittings, and supports.

Copper tubing should not be used in a hydraulic brake system. It is subject to fatigue cracking and corrosion, which can result in brake system failure.

Be sure to use a replacement hose that meets original equipment manufacturer (OEM) safety standards. It is also vital that the replacement hose is the same size as the original. A hose that is too long may rub on the chassis. One that is too short may break when the movable component reaches the limits of its travel.

There are two types of flares used in brake line fabrication: the double flare and the ISO flare. Single flares are never used in brake line work.

The ISO or bubble flare meets the requirements of the International Standards Organization.

Task A.2.5 Select, handle, store, and install proper brake fluids (including silicone fluids).

Silicone-based brake fluid is classified as DOT 5 fluid. This type of fluid is nonhydroscopic, which means it does not absorb water. Silicone-based brake fluid has a long-term shelf life and does not damage painted surfaces.

Commonly used nonpetroleum-based brake fluids are classified as DOT 3 or DOT 4. These fluids tend to absorb moisture from the air. Painted surfaces are damaged by DOT 3 and DOT 4 brake fluid.

DOT 5 silicone brake fluid should never be used in an ABS. Excessive wear of brake components and other conditions can occur from using the wrong fluid.

DOT 4 absorbs less moisture and has a higher boiling point than DOT 3. Brake fluid with a high boiling point is important in systems that generate a great amount of heat.

Task A.2.6 **Inspect brake lines and hoses for proper routing.**

3. Valves and Switches (non-ABS) (4 Questions)

Task A.3.1 **Diagnose poor stopping, pulling, or dragging caused by problems in the hydraulic system valve(s); determine needed repairs.**

The metering valve is used on systems with front disc and rear drum brakes. During a brake application, the brake fluid pressure has to overcome the force of the brake shoe return springs and force the shoes outward. Therefore, a brief time interval is required to apply the rear brakes whereas the front caliper pistons move the brake pads quickly against the rotors. The metering valve delays front brake fluid pressure during light brake applications so both front and rear brake applications occur at the same time.

Task A.3.2 **Inspect, test, and replace metering, proportioning, pressure differential, and combination valves.**

During a moderate brake application, the proportioning valve reduces pressure to the rear wheel brakes to compensate for the transfer of vehicle weight to the front wheels. This action prevents premature lockup of the rear wheels. During a light brake application, the proportioning valve does not affect rear wheel pressure. During high pressure pedal application the proportioning valve opens and allows full pressure to the rear wheels. When pressure gauges are connected to each proportioning valve inlet and outlet, during a moderate brake application, there should be a pressure difference (lower at the outlet).

A metering valve is a brake system valve used with disc/drum brake systems that keeps the front discs from operating until the rear drums have started to work. A proportioning valve is a brake system valve that functions to maintain the correct proportion between line pressures to the front and rear brakes and, therefore, to provide a balanced vehicle braking system.

A three-function combination valve is a brake failure light switch, proportioning valve, and a metering valve combined in one housing.

If the warning light does not come on during the test, but does light when a jumper is connected to ground, the warning switch portion of the combination valve has malfunctioned. The valve must be replaced.

To restore equal pressure in the primary and secondary sections of the master cylinder, perform a hard brake pedal application to center the warning switch piston after brake repairs are completed. If this action does not center the piston and put out the light, apply light brake pedal pressure and loosen a bleeder screw in the side of the brake system that had the high pressure during the failure.

Task A.3.3 **Inspect, test, replace, and adjust load- or height-sensing-type proportioning valve(s).**

The load-sensing proportioning valve is mounted on the chassis, and a linkage is connected from the valve to the rear axle. When the load is light, the linkage positions the internal valve so brake pressure is reduced to the rear wheels during moderate brake applications. A heavy load on the rear suspension reduces rear chassis height. This

action causes the linkage to move the valve in the height-sensing proportioning valve. Under this condition, the proportioning valve does not reduce pressure to the rear brakes during moderate brake application.

One type of load-sensing proportioning valve uses a bracket attached to the axle. A spring connects the bracket to a lever on the end of the proportioning valve, which is mounted to the vehicle chassis.

Another type of load-sensing proportioning valve uses a large round ball called a "G" ball in a valve assembly called a "G" valve. This assembly is mounted on the end of the proportioning valve. The ball moves back and forth in relation to the tilt of the rear of the vehicle.

During hard braking, the rear of the vehicle lifts, causing the valve to reduce pressure to the rear brakes, thus avoiding rear wheel lockup.

Task A.3.4 Inspect, test, and replace brake warning light, switch, and wiring.

When the pressure is equal in the primary and secondary sections of the master cylinder, the warning switch piston remains centered. In this position, the switch piston does not touch the switch pin. If the pressure is unequal between the primary and secondary master cylinder sections, the pressure difference moves the switch piston to one side. In this position, the switch piston pushes the spring-loaded switch pin upward and closes the warning switch light. This action illuminates the brake warning light.

The brake warning lamp circuit may be tested by grounding the warning switch with the ignition switch on. Under this condition, the bulb should light. If the bulb is not lit, check the fuse, bulb, and connecting wires.

4. Bleeding, Flushing, and Leak Testing (non-ABS) (4 Questions)

Task A.4.1 Bleed (manual, pressure, vacuum, or surge method) and/or flush hydraulic system.

A pressure bleeder has an adapter connected to the top of the master cylinder reservoir. A hose is connected from this adapter to the pressure bleeder chamber in the top of the pressure bleeder. The pressure bleeder has an air chamber below the fluid chamber, and a diaphragm that separates the air and fluid chambers. Shop air is used to pressurize the air chamber up to 15 to 20 psi (103 to 138 kPa). If the brake system has a metering valve, this valve must be held open with a special tool. The bleeder hose is connected from each bleeder screw into a container partially filled with brake fluid. Open the bleeder screw until a clear stream of brake fluid is discharged.

During the vacuum bleeding procedure, the vacuum pump is connected to a sealed container. Another hose is connected from this container to the bleeder screw. A one-way check valve is connected in the hose from the bleeder screw to the container. Operate the pump handle 10 to 15 times to create vacuum in the container. Open the bleeder screw until about 1 inch (25 mm) of brake fluid is pulled into the container. Repeat the procedure until the fluid coming into the container is free of air bubbles.

During a manual brake bleeding procedure, connect a bleeder hose from a bleeder screw into a container partially filled with brake fluid. Keep the end of this hose submerged below the level of the brake fluid in the container. Each wheel caliper or cylinder must be bled in the vehicle manufacturer's specified sequence in any bleeding procedure. Wheel calipers may be tapped with a soft hammer to help remove air bubbles.

The surge bleeding procedure may be used with manual or pressure bleeding. Bleed the brake system in the conventional manner. Surge bleeding involves pumping the brake pedal quickly several times with the bleeder screw closed. After surge bleeding, use the conventional bleeding procedure to bleed the system one more time.

Flushing a brake system is a continuation of the bleeding procedure. During a flushing procedure, each bleeder screw is opened until all the contaminated fluid is removed. Never reuse fluid from a bleeding or flushing procedure.

Task A.4.2 Pressure test brake hydraulic system.

The proportioning valves connected to the rear wheels may be tested by connecting pressure gauges on the master cylinder side and wheel cylinder side of each proportioning valve. When the brake pedal is applied with light pressure and the master cylinder pressure is below the split point pressure, both gauges should indicate the same pressure. If the brake pedal pressure is increased and the master cylinder pressure exceeds the split point pressure, the master cylinder pressure should exceed the wheel cylinder pressure by the manufacturer's specified amount.

After the brakes are bled, fill the master cylinder to the proper level. Following several firm applications of the pedal, the calipers should be checked for leaks at the piston seals and the hose attachment areas.

B. Drum Brake Diagnosis and Repair (6 Questions)

Task B.1 Diagnose poor stopping, pulling, or dragging caused by drum brake hydraulic problems; determine needed repairs.

A springy and spongy pedal is a condition where the brake pedal does not give firm resistance to foot pressure and feels elastic. It is normally caused by air in the hydraulic lines. Poor stopping ability may be caused by hydraulic problems such as contaminated fluid or air in the hydraulic system.

Brake drag may be caused by hydraulic problems such as contaminated brake fluid, inferior rubber caps in the master cylinder or wheel cylinders, or plugged compensating ports in the master cylinder. An obstructed brake line or hose may also be the cause of brake drag.

Reduced stopping ability may be caused by mechanical brake problems such as improper brake adjustment; wrong, glazed, or oil soaked linings; seized wheel cylinder pistons; or bell-mouthed, barrel-shaped, or scored drums. Poor stopping ability combined with brake pedal fade may be caused by drums that have been machined until they are thinner than specified.

Task B.2 Diagnose poor stopping, noise, pulling, grabbing, dragging, or pedal pulsation caused by drum brake mechanical problems; determine needed repairs.

Brake squeal may be caused by bent backing plates, distorted drums, linings loose at shoe ends, improper lining position on the shoe, weak or broken hold-down springs, or loose wheel bearings. Brake chatter may be caused by improper brake adjustment; loose backing plates; contaminated linings; out-of-round, tapered, or barrel-shaped drums; cocked or distorted shoes; or loose wheel bearings.

Pedal pulsation may be caused by out-of-round brake drums or by rotors with improper parallelism.

A restricted brake hose may cause the vehicle to stop poorly or pull to one side while braking, or the brake to drag. Pedal pulsation may be caused by excessive rotor runout and worn or loose wheel bearings.

Task B.3 Remove, clean, inspect, and measure brake drums; follow manufacturers' recommendations in determining need to machine or replace.

Brake drums should be inspected for cracks, heat checks, out-of-round, bell mouths, scoring, and hard spots. The inside drum diameter should be measured with a drum micrometer. If the drum diameter exceeds the maximum limit specified by the manufacturer, replace the drum. The drum diameter should be measured every 45 degrees around the drum. The maximum allowable out-of-round specified by some manufacturers is 0.0035 inch (0.09 mm). If the out-of-round exceeds specifications, the drum may

be machined if the machining does not cause the drum to exceed the maximum allowable diameter.

Use the brake adjustment gauge to measure the inside diameter of the drum braking surface. Adjust the brake shoe and lining diameter to fit the gauge. Turning the star wheel, adjust the shoe and lining diameter to approximately 0.03 inch to 0.05 inch (0.76 mm to 1 mm) less than the inside diameter of the brake drum. See the workshop manual for the exact specifications.

Use a brake adjustment gauge to measure the inside diameter of the drum braking surface. Turning the star adjuster, adjust the shoe and lining diameter to be approximately 0.03 to 0.05 inch (0.76 to 1.27 mm) less than the inside diameter of the drum braking surface for each wheel. See the service manual for exact specifications.

Task B.4 Machine drum according to manufacturers' procedures and specifications.

When machining a brake drum, the drum must be installed securely and centered on the lathe. A dampening belt must be installed tightly around the outside of the drum to prevent the cutting tool from chattering on the drum. Many manufacturers recommend a rough cut tool depth of 0.005 to 0.010 inch (0.127 to 0.254 mm) and a finish cut tool depth of 0.005 inch (0.127 mm). After the machining procedure, the drum should be sanded to remove minor irregularities. Many manufacturers recommend drum machining until the drum diameter is within 0.03 inch (0.76 mm) of the maximum allowable diameter.

The surface of a freshly refinished drum contains millions of tiny particles. These particles can remain free on the surface or can become lodged in open pores of the cast iron drum. If these particles are not removed they can become imbedded in the linings. Once imbedded in the linings, the linings become a fine grinding stone, which will score the brake drum.

Start removing the particles by wet washing the lining with hot water, followed by wiping it with a lint-free cloth. Use compressed air to remove the remaining moisture. Finally, use a lint-free cloth moistened with denatured alcohol or brake cleaning solution. Repeat the final step until the cloth shows no signs of dirt.

Task B.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.

The parking brake strut is a bar between the brake shoes. When the parking lever is actuated, the parking brake strut pushes the leading brake shoe into the drum. Drum brakes contain specific components that are vital to the self-adjusting nature of the drum brakes. As the brakes wear they will get more and more out of adjustment and eventually fail. All brake return springs should be inspected for distortion and stretching. Brake shoes should be cleaned with a shop towel and inspected for broken welds, cracks, wear, and distortion. If the wear pattern on the brake shoes is uneven, the shoes are distorted. Check all clips and levers for wear and bending. Inspect the brake linings for contamination with oil, grease, or brake fluid. Clean and lubricate adjusting and self-adjusting mechanisms.

A bent backing plate will not align the brake shoes properly. The misaligned shoes will result in brake drag or grab. Loose backing plate anchor bolts may cause brake chatter because the brake shoes can become misaligned if the backing plate moves.

While servicing a wheel cylinder, the parts should be washed in denatured alcohol or clean brake fluid. If the cylinder bore is pitted or deeply scored, the cylinder should be replaced. The flat side of the piston should face the cups. The piston cups should be lubricated with clean brake fluid before assembly.

If the brake shoes and linings have a slight blue coloring, this indicates overheating. In this case, the brake shoe adjusting screw springs and brake shoe hold-down springs should be replaced.

Linings must be replaced when covered with grease, oil, or brake fluid. Operating a vehicle for any length of time with worn brake shoes and linings will quickly result in scored brake drums. Always replace parts that are near the end of their service life. Never replace linings on one brake assembly without replacing those on the opposite wheel.

To check for leaks, pull back each wheel cylinder dust boot. Normally you will see a small amount of brake fluid present. This is not a cause for alarm as it acts as a lubricant for the piston. However, large amounts of fluid behind the boot indicate the fluid is leaking past the piston cups and an overhaul is in order.

Some wheel cylinders cannot be rebuilt. They are designed to be replaced as an assembly whenever there is leakage or signs of damage.

Check the brake shoe and lining pads where the brake shoes and linings rest. Look for any deep grooves in the brake shoe and lining contact pads that could resist brake shoe and lining movement. Hand sand any grooves in the braking surface. If grooves are still present after sanding, the backing plate must be replaced. Any attempt to remove the grooves by grinding may result in improper brake shoe and lining-to-brake drum contact.

With manual brake adjusters, the brakes must be periodically adjusted to limit pedal movement and the increased need for brake fluid. However, the wear is so gradual that the driver may not realize how much out of adjustment the brakes are until it's too late.

Automatic brake adjusters generally take the worry out of keeping the brakes properly adjusted. The automatic adjusters automatically adjust the clearance between the shoe linings and the drum.

Task B.6 Lubricate brake shoe support pads on backing (support) plate, self-adjuster mechanisms, and other brake hardware.

Dry brake shoe ledges on the backing plate may cause a squeaking noise during brake applications. Lightly scored brake shoe ledges on the backing plate may be resurfaced and lubricated with high temperature grease.

Whenever the rear brake shoe and linings are removed, the parking brake rear cable and conduit tension should be checked.

The ledges of the brake shoes that are positioned against the backing plates should be lubricated with the high-temperature grease recommended by the manufacturer.

Task B.7 Install brake shoes and related hardware.

The secondary shoe faces towards the rear of the vehicle, and the primary and secondary shoe return springs are not interchangeable. The adjuster cable is usually mounted on the secondary shoe.

The adjuster must be installed in the proper direction so the star wheel is accessible through the backing plate opening to allow for future removal of the shoes and to provide for self-adjusting.

The third marking identifies the friction code for the material. The letters "FE," "FF," and the like refer to the friction characteristics of the lining material. They do not reflect the quality of the lining.

Task B.8 Pre-adjust brake shoes and parking brake before installing brake drums or drum/hub assemblies and wheel bearings.

A high brake pedal after lining replacement does not indicate a job well done. It may indicate tight clearances that can lead to seating problems with the linings. When properly adjusted, the brakes will not drag and the wheel will turn freely.

Task B.9 Reinstall wheel, torque lug nuts, and make final checks and adjustments.

C. Disc Brake Diagnosis and Repair (13 Questions)

Task C.1 Diagnose poor stopping, pulling, or dragging caused by disc brake hydraulic problems; determine needed repairs.

Common causes of excessive pedal effort are glazed brake linings, seized caliper or wheel cylinder pistons, a restricted vacuum hose connected to the brake booster, or scored brake drums and rotors.

Wrong or loose brake pads, a loose caliper mounting, or a sticking caliper piston may cause pull to one side while braking. Seized master cylinder pistons do not contribute to pull while braking.

Dragging parking brakes would not cause a pull during braking because both rear brakes are being applied at the same time.

A seized brake caliper will usually cause the brake to drag. It will not, however, cause the wheel to shimmy.

Task C.2 Diagnose poor stopping, noise, pulling, grabbing, dragging, pedal pulsation, or pedal travel caused by disc brake mechanical problems; determine needed repairs.

A worn outer constant velocity joint does not cause brake pedal pulsation; it causes an audible clicking on acceleration and during turns. Brake pedal pulsation may be caused by worn or loose wheel bearings because the rotor is not properly aligned with the brake pads at initial brake application.

Task C.3 Retract integral parking brake caliper piston(s) according to manufacturers' recommendations.

Task C.4 Remove caliper assembly from mountings; clean and inspect for leaks and damage to caliper housing.

Return springs are not used in calipers, but spring are used in drum brakes. The brake fluid pressure is used to force the piston out of the caliper bore. Atmospheric pressure has little or no effect on the return of the caliper piston after brake application. After a brake application, the caliper piston is returned by the twisting action of the seal.

Task C.5 Clean, inspect, and measure caliper mountings and slides for wear and damage.

A leaking caliper piston seal will cause weak braking action and excessive brake pedal travel. Excessive wear on the inside brake pad lining compared to the outside lining may be caused by worn caliper pins and bushings, loose or worn wheel bearings, or sticking caliper pistons.

Inspect the caliper slide pins and sleeve assemblies for corrosion and inspect all bushings for cuts and nicks. If damage to any of these parts is found, install new parts when the caliper is reinstalled. Do not attempt to polish away corrosion.

Task C.6 Remove, clean, and inspect pads and retaining hardware; determine needed repairs, adjustments, and replacements.

A scraping noise while braking may be caused by a pad wear sensor contacting the rotor. The scraping of the wear indicator indicates that the brake shoes on that axle set need replacement. If caught early, minimal damage will be done to the rotors. Remember that when resurfacing or replacing the rotors, the axle set must be either replaced together or have the same amount of machining done.

Shop manuals all specify minimum pad thickness, but the pads can only be measured if the unit is disassembled. When making a visual judgment concerning pad wear, consider any pad that is worn to the thickness of the backing pad as being in need of replacement. Inspect disc brake rotors whenever the pads or calipers are serviced, or when the wheels are rotated or removed for any other work.

Task C.7 Disassemble and clean caliper assembly; inspect parts for wear, rust, scoring, and damage; replace all seals, boots, and any damaged or worn parts.

Minor scratches and surface imperfections should be removed with crocus cloth. The caliper bore may be honed with the proper brake hone lubricated with brake fluid. The maximum allowable increase in caliper bore when honing is 0.001 inch (0.025 mm). Anything beyond that and the caliper must be replaced.

When reassembling a brake caliper, the seal should be installed followed by the boot. The piston should be lubricated with clean brake fluid before it is installed, and the bleeder screw hole or high-pressure inlet should be open when installing the piston. The piston seal and boot should be lubricated with clean brake fluid prior to installation.

Inspect the caliper for evidence of brake fluid in and around the boot area. If brake fluid is evident, the caliper seal must be replaced. Replace the boot if it is torn, damaged, or cracked. If the caliper ears are worn, broken, or elongated, replace the caliper.

On vehicles equipped with floating calipers, check for uneven wear on the inboard and outboard linings. If the inboard pad shows more wear than the outboard, the caliper should be overhauled. If the outboard shows more wear, the sliding components of the assembly may be sticking, bent, or damaged.

Task C.8 Reassemble caliper.

During reassembly, the piston seal is lubricated with silicone grease. The piston boot is lubricated with rubber grease or brake fluid. The caliper cylinder and piston are lubricated with brake fluid.

Task C.9 Clean, inspect, and measure rotor with a dial indicator and a micrometer; follow manufacturer's recommendations in determining need to machine or replace.

The rotor is measured for parallelism or thickness variation; this measurement should be made at eight locations (every 45 degrees) around the rotor. These measurements should be taken near the center of the friction surface. Replace the rotor if the thickness variations exceed the manufacturer's specifications.

A brake rotor should be refinished if it fails lateral runout or thickness variation checks, if there is noticeable brake pulsation, or if there are heat spots or excessive scoring. The minimum thickness dimension information appears in the casting of the rotor; refer to the service manual for exact specifications. Ventilated rotors have cooling fins cast between the braking surfaces. This construction considerably increases the cooling area of the rotor.

Do not automatically refinish brake rotors when performing routine brake maintenance such as replacing worn disc brake pads. Refinish the rotor only under the following conditions:

- the rotor fails lateral runout or thickness variation checks,
- there is noticeable brake pedal pulsation, and/or
- there are heat spots or excessive scoring.

All brake rotors have a minimum thickness dimension cast into them. This dimension is the minimum wear dimension, not a minimum refinishing dimension. Always, refer to the service manual for the proper specifications.

Task C.10 Remove and replace rotor.

When installing new brake rotors, most shop manuals caution against refinishing the surfaces as these parts are already at the correct level of surface finish. Making a light cut on a new rotor may produce excessive lateral runout and result in brake shudder after only a few thousand miles of service. Clean any oil film off the rotor with solvent, and allow the rotor to air dry before installing it on the vehicle.

If the rotor cannot be pulled off by hand, apply rust penetrant on the front and rear of the rotor/hub mating surface. Strike the rotor between the studs using a rubber or plastic hammer. If this does not free the rotor, attach a three-jaw puller to the rotor and pull it off.

Task C.11 Machine rotor using on-car or off-car method, according to manufacturer's procedures and specifications.

During the machining process, a vibration damper must be positioned around the outside diameter of the rotor. Both sides of the rotor should be machined before removing it from the lathe, and a sanding pad should be used to sand the rotor surface after machining. Equal amounts of metal must be removed from each side of the rotor on fixed caliper rotors.

To determine the approximate amount of metal to be removed, turn on the lathe and bring the cutting bit up against the rotating disc until signs of a slight scratch are visible. Turn off the lathe and reset the depth-of-cut dial indicator to zero. Find the deepest groove on the face of the rotor and move the cutting bit to that point without changing its depth-of-cut position. Now use the depth-of-cut dial to bottom out the tip of the cutter in the deepest groove. The reading on the dial now equals or is slightly less than the amount of material needed to be removed to eliminate all of the grooves in the rotor surface. For the best results with cuts that have a total depth greater than 0.015 inch (0.381 mm), take two or more shallow cuts rather than one very deep cut. It is very important that the rotor surface be made nondirectional.

Task C.12 Install pads, calipers, and related attaching hardware; bleed system.

The inboard and outboard brake pads are not interchangeable in most calipers. If there is clearance between the pad retainer and the caliper retainer ledge, brake pad rattle may occur.

When one caliper is bad, both calipers should be replaced. The use of loaded calipers will ensure that all of the components that need to be replaced get replaced. Loaded calipers are calipers that come fully installed with brake pads and mounting hardware. They eliminate the need to overhaul calipers and prevent many errors when performing caliper service. Loaded calipers also reduce labor time.

Asbestos brake pads are made from an asbestos mixture called matrix, which is cured in cement. The health dangers of asbestos have led to a phase-out of this material.

Task C.13 Adjust calipers with integrated parking brakes according to manufacturer's recommendations.

The parking brake mechanism moves the rear caliper piston toward the rotor surface. The parking brake should be released during an adjustment. The parking brake cable should be adjusted so the stopper pin just contacts the stop.

Task C.14 Fill master cylinder to proper level with recommended fluid; inspect caliper for leaks.

On most cast iron master cylinders, the brake fluid level should be 0.25 inch (6.35 mm) below the top of the casting surface.

Task C.15 Reinstall wheel, torque lug nuts, and make final checks and adjustments.

An impact wrench should not be used to tighten wheel lug nuts since the excessive torque from this procedure may distort drums and cause excessive rotor runout.

D. Power Assist Units Diagnosis and Repair (4 Questions)

Task D.1 Test pedal free travel with and without engine running to check power booster operation.

With the engine stopped, pump the brake pedal several times, and hold the pedal in the applied position. When the engine is started, the pedal should move slightly downward if the vacuum supply to the brake booster is normal. If the pedal does not move slightly downward, check the vacuum hose and the one-way check valve to the brake booster.

When the driver releases the brake pedal, the master cylinder return stroke begins. The return spring forces the piston back into its released position. As the piston moves back, it pulls away from the fluid faster than the fluid can make its way back from the brake lines into the pressure chamber. When this happens, a low pressure is created ahead of the piston.

Fluid flows through the piston or around the lips of the cup and into the pressure chamber. When the piston is fully returned to its at-rest position, the space in front of the piston is full of fluid. The fluid returning from the brake lines should flow back up into the reservoir. If the replenishing port is plugged, the brakes will not release, creating a hard pedal with resistance.

The brake pedal should be firm at the specified pedal height. If the pedal slowly sinks toward the floor, there is an internal master cylinder leak or an external leak in the lines, fittings, hoses, wheel cylinders, or calipers. When there are no external leaks, the master cylinder must be leaking internally.

To check the vacuum brake booster for air tightness, operate the engine for two minutes and then shut off the engine. Pump the brake pedal several times with normal braking pressure. If the brake booster is operating normally, the pedal should go down normally on the brake application. The pedal should gradually become higher with each pedal application.

Task D.2 Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.

The vacuum gauge should be installed between the one-way check valve and the brake booster to check the vacuum supply. With the engine idling, the vacuum should be above 12 inches Hg (40 kPa absolute).

Task D.3 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.

To check a one-way check valve in the brake booster vacuum hose, operate the engine at 2,000 rpm and then allow the engine to idle. Shut the engine off and wait 90 seconds. Pump the brake pedal 5 or 6 times. The first two pedal applications should be power assisted. If the first two brake applications are not power assisted, the one-way check valve is defective in the brake booster vacuum hose.

Insufficient manifold vacuum, leaking or collapsed vacuum lines, punctured diaphragms, or leaky piston seals can all result in weak power-unit operation. A steady hiss when the brake pedal is held down indicates a leak that can cause poor power-unit operation. Hard brake pedal is usually the first signal that the unit is on the way to complete failure.

Connect a vacuum gauge with a T-connection in the hose between the one-way check valve and the brake booster. With the engine idling, the vacuum should be 17 to 21 inches Hg (44 to 30.4 kPa absolute). If the vacuum is low, connect the vacuum gauge directly to the intake manifold and check this reading against the manufacturer's specifications.

Task D.4 Inspect and test hydro-boost system and accumulator for leaks and proper operation; repair, adjust, or replace parts as necessary.

If the brake pedal height remains unchanged, there is no accumulator pressure to supply power assist. This may be caused by low power steering pump pressure, but this problem also reduces steering assist. This informs us that power steering operation is normal, and low power steering pump pressure is not the cause of the complaint. A defective accumulator may cause reduced power brake assist.

If leakage is evident around the pump, clean and tighten all fittings and bolts. If the leak continues, track it down and determine the necessary action.

Fluid leakage from the housing cover ends of the booster near the reaction bore requires booster replacement. Fluid leakage from the vent at the front of the unit near the master cylinder indicates a leaking piston seal. Replace the seal. Fluid leakage between the housing and the housing cover indicates a defective seal. Replace the seal. Fluid leakage near the plug area indicates the need to replace the spool valve seal and the accumulator cap seal. Fluid leakage at the return port indicates the need to replace the accumulator cap seal.

E. Miscellaneous Systems (Wheel Bearings, Parking Brakes, Electrical, etc.) Diagnosis and Repair (7 Questions)

Task E.1 Diagnose wheel bearing noises, wheel shimmy, and vibration problems; determine needed repairs.

Task E.2 Remove, clean, inspect, repack wheel bearings, or replace wheel bearings and races; replace seals, adjust wheel bearings according to manufacturer's specifications.

After tightening the wheel bearing nut to 25 ft. lbs. (33.9 Nöm), the wheel bearing adjusting nut should be loosened one-half turn and tightened to 10 to 15 in. lbs. (11.5 to 17.3 cm-kg).

Bearings must always be reinstalled into the same cone (race). Do not interchange the right and left side bearings. A bearing installed into the wrong cone (race) will wear out quickly.

Never spin dry bearings using an air nozzle. The bearing may spin too fast and fly apart.

Task E.3 Check parking brake system; inspect cables and parts for wear, rusting, and corrosion; clean or replace parts as necessary; lubricate assembly.

On many vehicles, the parking brake cable should be adjusted so there is a slight drag, and then loosened two turns. The brake shoes should be properly adjusted before a parking brake adjustment.

Plastic-coated cables do not require periodic lubrication. The plastic coating helps the cables slide smoothly against the nylon seals inside the conduit end fittings. These cables should be handled with care. Avoid contact with sharp-edged tools or sharp surfaces on the vehicle underbody.

Task E.4 Adjust parking brake assembly; check operation.

Brake shoe adjustment does not affect the propeller type of parking brake. During the parking brake adjustment, the specified pin is installed in a hole in the parking pedal mechanism. The parking brake is applied until the pin contacts the outer flange on the pedal mechanism.

Some rear disc brakes have a small drum brake built into the center of the rotor. Two brake shoes are expanded into the brake drum when the parking brake is applied. The shoes should be adjusted to have a small amount of clearance between them and the drum; refer to the shop service manual for exact specifications and procedures.

Carefully inspect the entire length of the parking brake cable. Look for signs of fraying, breakage, or deterioration.

The front cable couples the parking brake control assembly to a device called an equalizer. The equalizer is used to provide a balanced braking force at each wheel.

Parking brakes that are adjusted too tight will drag and wear prematurely.

Task E.5 Test the service and parking brake indicator and warning light(s), switch(es), and wiring.

A continually illuminated brake warning light may be caused by a grounded wire to the parking brake switch, a continually closed parking brake switch, or low fluid level in one section of the master cylinder reservoir. If an open circuit occurs in the wire to the parking brake switch, the brake warning light is not illuminated when the parking brake is applied.

When the parking brake pedal is applied, it closes a switch which completes an electric circuit to the brake indicator light in the instrument panel. The parking brake applied indicator light will then light when the ignition is turned on. The light goes out when the parking brake is released or the ignition is turned off. In some vehicles, this same indicator light may be used to alert the driver to problems in the anti-lock brake system.

Task E.6 Test, adjust, and repair or replace brake stoplight switch, lamps, and related circuits.

The stoplight switch may be adjusted on many vehicles. In most applications, this switch should be adjusted so the lights are illuminated when the brake pedal is depressed 0.25 inch (6.35 mm). An improper stoplight switch adjustment or a binding brake pedal may cause the stoplight to be illuminated continually with the ignition switch on. Stoplight circuits vary depending on the vehicle make and model year; the technician must use a wiring diagram to diagnose each circuit. When diagnosing the stoplight circuit, the stoplight circuit should be tested first.

F. Anti-lock Brake System (ABS) Diagnosis and Repair (11 Questions)

Task F.1 Follow accepted service and safety precautions when inspecting, testing, and servicing the ABS hydraulic, electrical, and mechanical components.

The high-pressure accumulator must be discharged before a brake line is disconnected, and some manufacturers recommend relieving accumulator gas pressure before accumulator disposal.

Most of the services done to the brakes of an anti-lock brake system are identical to those in a conventional brake system. There are, however, some important differences. One of these is the bleeding of the brake system. Always refer to the appropriate procedures in the service manual before attempting to service the brakes on an ABS-equipped vehicle. Before servicing an anti-lock brake system, it is important that you understand the basics of electrical and electronic troubleshooting. Without this basic understanding, it will be difficult to follow the diagnostic procedures given in most service manuals.

Task F.2 Diagnose poor stopping, wheel lockup, pedal feel and travel, pedal pulsation, and noise problems caused by the ABS; determine needed repairs.

The clicking noise during initial driving is a result of the ABS computer prove-out mode in which the computer momentarily energizes the solenoid in the ABS system. On many systems, pedal pulsations are normal during ABS function; however, pedal pulsation during a normal stop when the ABS function is not operating may be caused by out-of-round drums or rotors with excessive runout.

Rear tires of unequal size may result in wheel lockup on one rear wheel during the ABS mode. Larger than specified tires on both rear wheels may cause lockup on both rear wheels during ABS mode.

Many ABS components are simply remove-and-replace items. Normal brake repairs, such as replacing brake pads, caliper replacement, rotor machining or replacement, brake hose replacement, master cylinder or power booster replacement, or parking brake repair, can all be performed as usual. In other words, brake service on an ABS-equipped vehicle is similar to service on a conventional system with few exceptions. However, before beginning any service, depressurize the accumulator to prevent personal injury from high-pressure fluid. This is accomplished by pumping the brake pedal (ignition off) until the pedal becomes hard.

Task F.3 Observe ABS warning light(s) at start-up and during road test; determine if further diagnosis is needed.

An applied parking brake, low fluid level in the master cylinder, or accumulator pressure below 1,500 psi (10,343 kPa) may cause red brake warning light illumination. An open wheel speed sensor winding does not cause illumination of the red brake warning light, but results in illumination of the amber ABS light.

All ABS have some sort of self-test. This test is activated each time the ignition switch is turned on. You should begin all diagnostics with this simple test. To perform a typical ABS self-check sequence, place the ignition switch in the START position while observing both the red system light and the amber ABS indicator lights. Both lights should turn on. Start the vehicle. The red brake system light should turn off. With the ignition switch in the RUN position, the anti-lock brake control module performs a preliminary self-check on the anti-lock electrical system. During the self-check the light remains on (three to six seconds) and then should turn off. If a malfunction is detected during the test, the light will remain on and the system will shut down.

Task F.4 Diagnose ABS electronic control(s) components and circuits using self-diagnosis and/or recommended test equipment; determine needed repairs.

An open circuit at the R/R wheel speed sensor terminal does not cause a code representing the L/R wheel speed sensor. A larger tire than specified on the L/R wheel may affect the ABS operation, but it does not result in this type of diagnostic trouble code (DTC). An open circuit at the electronic brake control relay winding causes an inoperative ABS, but this problem does not result in a DTC representing the L/R wheel speed sensor. A grounded circuit to the L/R wheel speed sensor may cause a DTC representing the L/R wheel.

Many ABSs do not provide flash codes, and the DTCs must be obtained with the scan tool on these systems. A DTC indicates a defect in a certain area. In most cases, a voltmeter or ohmmeter test must be performed to locate the exact cause of the problem.

On an integral ABS with a high-pressure accumulator, the brake fluid level in the master cylinder should be checked with a fully charged accumulator. Under this condition, the brake fluid should be at the specified level in the master cylinder reservoir.

Task A.4.2 Pressure test brake hydraulic system.

The proportioning valves connected to the rear wheels may be tested by connecting pressure gauges on the master cylinder side and wheel cylinder side of each proportioning valve. When the brake pedal is applied with light pressure and the master cylinder pressure is below the split point pressure, both gauges should indicate the same pressure. If the brake pedal pressure is increased and the master cylinder pressure exceeds the split point pressure, the master cylinder pressure should exceed the wheel cylinder pressure by the manufacturer's specified amount.

After the brakes are bled, fill the master cylinder to the proper level. Following several firm applications of the pedal, the calipers should be checked for leaks at the piston seals and the hose attachment areas.

B. Drum Brake Diagnosis and Repair (6 Questions)

Task B.1 Diagnose poor stopping, pulling, or dragging caused by drum brake hydraulic problems; determine needed repairs.

A springy and spongy pedal is a condition where the brake pedal does not give firm resistance to foot pressure and feels elastic. It is normally caused by air in the hydraulic lines. Poor stopping ability may be caused by hydraulic problems such as contaminated fluid or air in the hydraulic system.

Brake drag may be caused by hydraulic problems such as contaminated brake fluid, inferior rubber caps in the master cylinder or wheel cylinders, or plugged compensating ports in the master cylinder. An obstructed brake line or hose may also be the cause of brake drag.

Reduced stopping ability may be caused by mechanical brake problems such as improper brake adjustment; wrong, glazed, or oil soaked linings; seized wheel cylinder pistons; or bell-mouthed, barrel-shaped, or scored drums. Poor stopping ability combined with brake pedal fade may be caused by drums that have been machined until they are thinner than specified.

Task B.2 Diagnose poor stopping, noise, pulling, grabbing, dragging, or pedal pulsation caused by drum brake mechanical problems; determine needed repairs.

Brake squeal may be caused by bent backing plates, distorted drums, linings loose at shoe ends, improper lining position on the shoe, weak or broken hold-down springs, or loose wheel bearings. Brake chatter may be caused by improper brake adjustment; loose backing plates; contaminated linings; out-of-round, tapered, or barrel-shaped drums; cocked or distorted shoes; or loose wheel bearings.

Pedal pulsation may be caused by out-of-round brake drums or by rotors with improper parallelism.

A restricted brake hose may cause the vehicle to stop poorly or pull to one side while braking, or the brake to drag. Pedal pulsation may be caused by excessive rotor runout and worn or loose wheel bearings.

Task B.3 Remove, clean, inspect, and measure brake drums; follow manufacturers' recommendations in determining need to machine or replace.

Brake drums should be inspected for cracks, heat checks, out-of-round, bell mouths, scoring, and hard spots. The inside drum diameter should be measured with a drum micrometer. If the drum diameter exceeds the maximum limit specified by the manufacturer, replace the drum. The drum diameter should be measured every 45 degrees around the drum. The maximum allowable out-of-round specified by some manufacturers is 0.0035 inch (0.09 mm). If the out-of-round exceeds specifications, the drum may

Task F.9 **Remove and install ABS components following manufacturer's procedures and specifications; observe proper placement of components and routing of wiring harness.**

Task F.10 **Diagnose, service, and adjust ABS speed sensors and circuits following manufacturers' recommended procedures (includes voltage output, resistance, shorts to voltage/ground, and frequency data).**

If a DTC is obtained representing a wheel speed sensor, the sensor and connecting wires may be tested with an ohmmeter. Disconnect the ABS computer wires and connect the ohmmeter leads to the appropriate sensor wires to test the sensor for an open circuit. When an infinite reading is obtained, the sensor or connecting wires are open. Disconnect the wiring connector at the sensor, and connect the ohmmeter leads to the sensor terminals to determine if the open circuit is in the sensor windings or connector wires. When the ohmmeter leads are connected from one of the wheel speed sensor terminals at the ABS computer connector to the ground, an infinite reading should be obtained. If the ohmmeter provides a low reading, the sensor winding or connecting wires are shorted to ground.

Task F.11 **Diagnose ABS braking problems caused by vehicle modifications (tire size, curb height, final drive ratio, etc.) and other vehicle mechanical and electrical/electronic modifications (communication, security, radio, etc.).**

Changing the wheel and tire sizes significantly different than OEM wheel and tire sizes may cause improper ABS operation. The control module will look at the wheel speed sensors and expect to see a specific rate of wheel deceleration when stopping normally. A lower profile tire will turn at a higher speed and have a higher rate of deceleration when braking. This may cause the anti-lock brake system to activate at the wrong time. It may cause the ABS warning light to come on and store a wheel speed sensor fault code. Larger profile tires may cause longer response time for the ABS to activate. If tire or wheel sizes are changed, the control module and/or other ABS components may also need to be changed.

Task F.12 **Repair wiring harness and connectors following manufacturers' procedures.**

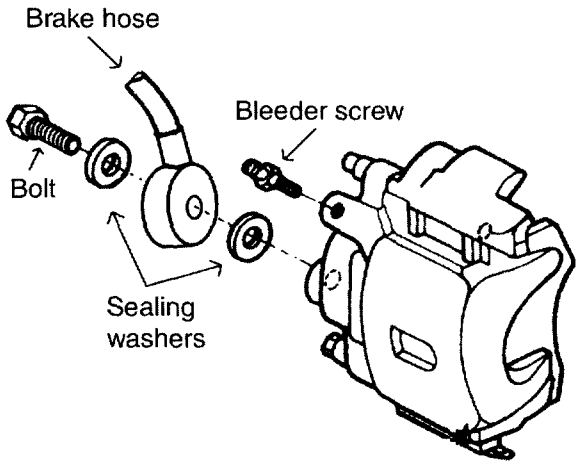
5 Sample Test for Practice

Sample Test

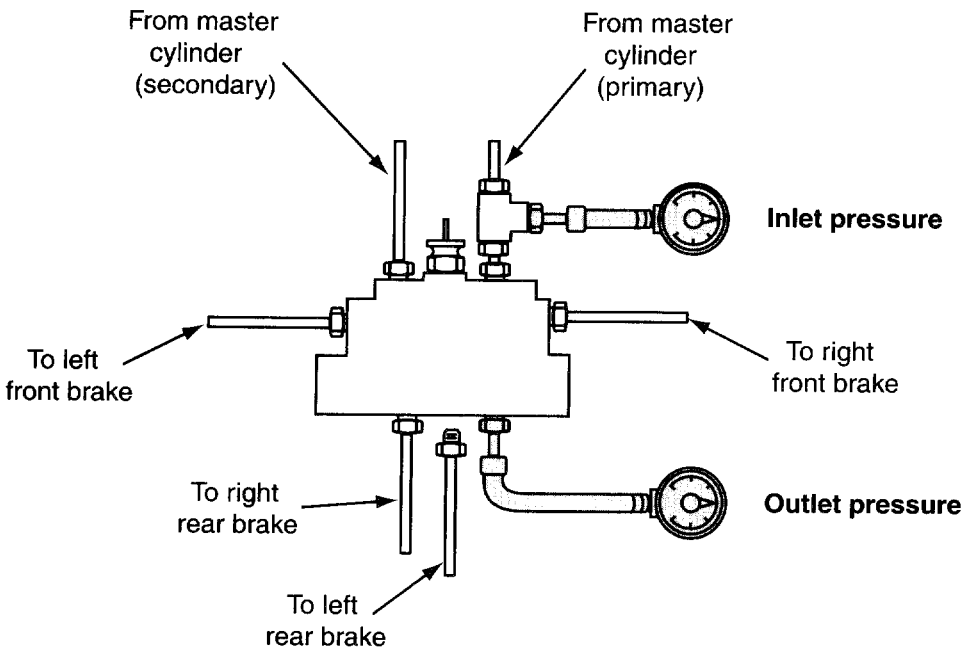
Please note the letter and number in parentheses following each question. They match the overview in section 4 that discusses the relevant subject matter. You may want to refer to the overview using this cross-referencing key to help with questions posing problems for you.

1. While discussing a vehicle with dragging brakes, Technician A says fluid may be leaking past the master cylinder cups. Technician B says the stoplight and cruise control switch may require adjusting. Who is right?
   A. A only
   B. B only
   C. Both A and B
   D. Neither A nor B (A.1.1)
2. The brake pedal is low and spongy; all brake adjustments have been completed according to specifications. The cause of the problem could be:
   A. Binding pedal linkage.
   B. Dented brake line.
   C. Plugged compensating port.
   D. A weak hydraulic hose. (A.1.2)
3. A vehicle has no brake pedal free play. This problem may cause:
   A. a low brake pedal.
   B. pressure build-up and dragging brakes.
   C. a spongy brake pedal.
   D. fluid leaking past the primary piston cups. (A.1.3)
4. With the engine running and the brake pedal applied and held with medium foot pressure, the brake pedal slowly moves downward. Technician A says brake fluid may be leaking past the master cylinder piston cups. Technician B says brake fluid may be leaking from a brake hose at one of the front wheels. Who is right?
   A. A only
   B. B only
   C. Both A and B
   D. Neither A nor B (A.1.4)
5. There are signs of paint removal and peeling on the power brake booster right below the master cylinder. The cause of this could be:
   A. A leaking secondary cup on the primary piston.
   B. A defective diaphragm in the brake booster.
   C. A leaking secondary cup on the secondary piston.
   D. Fuel being drawn into the booster by the vacuum. (A.1.5)

6. When removing the master cylinder, all of the following steps must be performed EXCEPT:
   A. Relieve any vacuum boost pressure (if equipped with power brakes).
   B. Plug the ends of the brake lines to prevent fluid loss.
   C. Disconnect the float level sensor.
   D. Drain the master cylinder. (A.1.6)
7. Technician A says that any time the brake lines are disconnected (or loosened) from the master cylinder, it has to be bled. Technician B says any time the brake system is worked on, the master cylinder must be bled. Who is right?
   A. A only
   B. B only
   C. Both A and B
   D. Neither A nor B (A.1.7)
8. After the master cylinder is bled and installed, excessive brake pedal effort is required for brake application. Technician A says the vacuum hose connected to the brake booster may be restricted. Technician B says there may be insufficient clearance between pushrod and piston that allows pressure to build up in the system. Who is right?
   A. A only
   B. B only
   C. Both A and B
   D. Neither A nor B (A.1.6)
9. A vehicle pulls to the left during a brake application. The cause of the problem could be:
   A. The right front brake linings are contaminated with grease.
   B. The piston is seized in the right front brake caliper.
   C. The master cylinder pistons are swollen from contaminated fluid.
   D. The secondary compensating port is plugged in the master cylinder. (A.2.1)
10. While discussing brake lines, Technician A says a damaged brake line may be repaired with a short piece of line and compression fittings. Technician B says the necessary brake line bends should be made with a tubing bending tool. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (A.2.2)



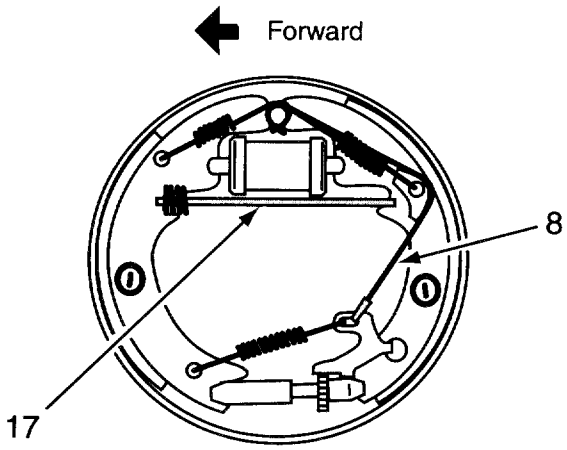
11. While discussing brake hose replacement, Technician A says the sealing washer on the male end of a brake hose shown in the illustration may be reused. Technician B says the brake line fitting should be installed and tightened in the female end of the brake hose before the male end is installed. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (A.2.3)
12. Brake systems contain all of the following components EXCEPT:
    A. double wall copper tubing.
    B. high pressure rubber tubing.
    C. double wall steel tubing.
    D. flare nuts. (A.2.4)
13. While discussing brake fluids, Technician A says silicone-based brake fluids are hydroscopic. Technician B says DOT 3 and DOT 4 brake fluids tend to absorb moisture. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (A.2.5)
14. A metering valve delays pressure to which set of brakes under which braking condition?
    A. The rear brakes under light braking
    B. The rear brakes under heavy braking
    C. The front brakes under light braking
    D. The front brakes under heavy braking (A.3.1)



15. The pressure gauges connected to the proportioning valve input and output in the figure should indicate:
    A. higher pressure at the output compared to the inlet during a moderate brake application.
    B. the same pressure at the input and the output during a moderate brake application.
    C. lower pressure at the output compared to the input during a moderate brake application.
    D. lower pressure at the output compared to the input during a light brake application. (A.3.2)
16. While discussing a load-sensing proportioning valve, Technician A says this valve reduces brake pressure to the rear wheels as the rear suspension load increases. Technician B says this valve has linkage connected from the valve to the rear chassis. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (A.3.3)
17. The operation of a brake system failure switch is being discussed. Technician A says the light comes on when there is a pressure difference on one side of the switch. Technician B says the light comes on when pressure is the same on both sides of the switch. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (A.3.4)
18. To test the brake warning light circuit:
    A. Drain the master cylinder, start the engine, and watch for the warning light to illuminate.
    B. Disconnect the switch, start the engine, and apply moderate brake pressure.
    C. Replace the switch because it may be faulty.
    D. Ground the warning switch wire with the ignition on. (A.3.4)

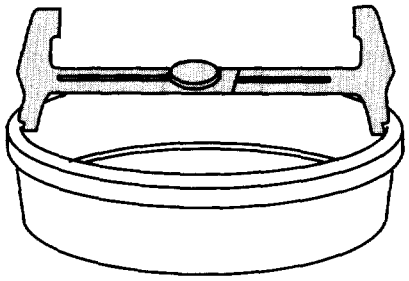
19. While discussing pressure brake bleeding, Technician A says the metering valve should be closed. Technician B says the pressure bleeder has an air chamber below the fluid chamber, and a diaphragm that separates the fluid and air chambers. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (A.4.1)
20. All of these statements about vacuum brake bleeding are true EXCEPT:
    A. The vacuum pump handle should be operated 10 to 15 times before the bleeder screw is opened.
    B. The vacuum pump creates a vacuum in the pump reservoir.
    C. The bleeder screw should be opened until there is approximately 1 in (25 mm) of brake fluid in the reservoir.
    D. A one-way check valve is required in the line from the bleeder screw to the reservoir. (A.4.1)
21. All of these statements about manual brake bleeding procedures are true EXCEPT:
    A. A hose is connected to the bleeder screw, and the opposite end of this hose is submerged in a container of brake fluid.
    B. Apply the brake pedal with moderate pressure and then open the bleeder screw.
    C. When the bleeder screw is opened and the pedal goes to the floor, release the pedal and close the screw.
    D. Repeat the bleeding procedure until the fluid escaping from the bleeder hose is free of air bubbles. (A.4.1)
22. During a surge bleeding procedure:
    A. The end of the bleeder hose must be kept above the level of the fluid in the container.
    B. Pump the pedal quickly several times with the bleeder screw closed.
    C. Pump the pedal quickly several times while opening the bleeder screw.
    D. Decrease the pressure bleeder chamber pressure to 10 psi (69 kPa). (A.4.1)
23. When pressure testing a hydraulic brake system equipped with a metering valve and proportioning valves:
    A. During moderate brake application, the pressure at the master cylinder should exceed the pressure at the front wheel calipers.
    B. Below the split point pressure, the pressure at the master cylinder should exceed the pressure at the rear wheel cylinders.
    C. During a moderate brake application, the pressure should be equal at the front and rear wheels.
    D. Above the split point pressure, the pressure at the master cylinder outlet should exceed the pressure at the rear wheel cylinders. (A.4.2)
24. A vehicle experiences poor stopping, and the pedal feels springy and spongy during brake application. Technician A says the vents in the master cylinder cover may be plugged. Technician B says there may be air in the hydraulic system. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (B.1)

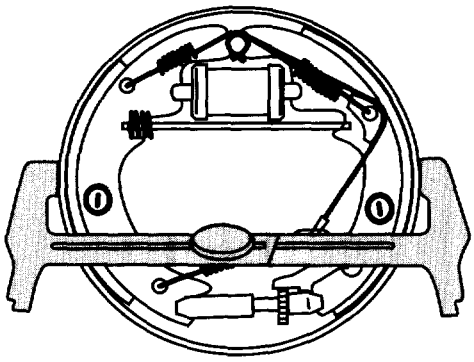
25. A vehicle experiences brake squeal during brake application. Technician A says the drums may be distorted. Technician B says the backing plates may be bent. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (B.2)
26. All of the following statements are true about brake drum inside diameter measurements with a brake drum micrometer EXCEPT:
    A. The drum should be cleaned before measuring the diameter.
    B. If the drum diameter is less than specified, replace the drum.
    C. The diameter should be measured at two locations around the drum.
    D. The drum diameter variation should not exceed 0.0035 in (0.009 mm). (B.3)
27. While machining a brake drum:
    A. Tool chatter marks may be caused by excessive damping belt tension.
    B. The tool bit depth for a rough cut should be 0.005 to 0.010 in (0.127 to 0.254 mm).
    C. The tool bit depth for a rough cut should be 0.010 to 0.020 in (0.254 to 0.508 mm).
    D. The tool bit depth for a finish cut should be 0.008 to 0.010 in (0.203 to 0.127 mm). (B.4)



28. Refer to the illustration. Technician A says if component number 17 is omitted during brake hardware assembly, the brake will grab on the wheel. Technician B says if item number 8 is omitted during brake assembly, there will be no self-adjusting action. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (B.5)
29. While discussing brake backing plates, Technician A says a bent backing plate may cause brake grabbing. Technician B says a loose anchor bolt may cause brake chatter. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (B.2)

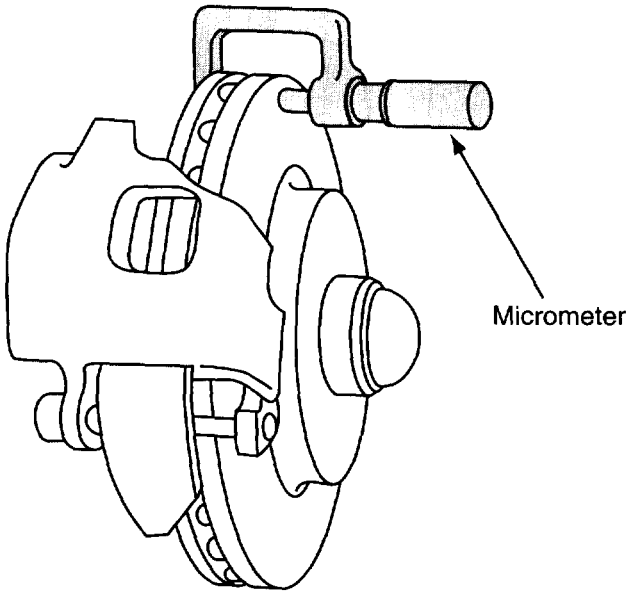
30. While servicing a wheel cylinder:
    A. The parts should be washed in a soap and water solution.
    B. If the cylinder is pitted or deeply scored, hone the wheel cylinder.
    C. The piston cups should be lubricated with clean brake fluid before installation.
    D. During assembly, the flat side of the pistons face the brake shoe links. (B.5)
31. While discussing brake hardware service, Technician A says dry shoe ledges on the backing plates may cause a squeaking noise during brake application. Technician B says slightly scored shoe ledges on the backing plates may be resurfaced and lubricated with high-temperature grease. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (B.2)
32. While assembling the brake shoes and related hardware:
    A. The secondary shoe faces toward the front of the vehicle.
    B. The primary and secondary shoe return springs are interchangeable.
    C. The adjuster must be installed in the proper direction.
    D. The adjuster cable usually is mounted on the primary shoe. (B.7)





33. Technician A says the brake shoes shown in the figure are being adjusted to match the brake drum size. Technician B says the brake shoes are being measured for wear. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (B.8)

34. When making final adjustments on the drum brakes:
    A. The star adjuster should be adjusted until there is a slight drag on the wheel.
    B. The star adjuster should be adjusted until the shoes hold the wheel firmly in place and then backed off until there is a slight drag on the wheel.
    C. The star adjuster should be adjusted until there is a slight drag on the drum and then backed off until the wheel spins freely.
    D. The star adjuster should be adjusted one full turn to back the shoes further away from the drum. (B.9)
35. All of these defects may cause a car to pull to one side while braking EXCEPT:
    A. wrong or loose brake pads.
    B. loose caliper mounting bracket.
    C. seized master cylinder piston.
    D. sticking caliper pistons. (C.1)
36. Excessive brake pedal pulsation is experienced while braking. Technician A says the outer constant velocity joint may be worn. Technician B says the front wheel bearing may be worn and loose. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (C.2)
37. After a brake application, the caliper piston is returned by:
    A. the twisting action of the seal.
    B. a return spring.
    C. brake fluid pressure.
    D. atmospheric pressure. (C.7)
38. On a single piston floating caliper, the inside brake pad lining is worn out, but there is very little wear on the outside pad lining. The cause of the problem could be:
    A. worn caliper pins and bushings.
    B. a leaking caliper piston seal.
    C. a leaking brake hose.
    D. excessive rotor lateral runout. (C.7)
39. On a vehicle with front disc and rear drum brakes, a scraping noise is present in one front wheel while braking. The cause of this problem could be:
    A. worn caliper pins and bushings.
    B. the pad wear sensor contacting the rotor.
    C. loose caliper mounting bolts.
    D. a loose pad mounting in the caliper. (C.7)
40. After honing a brake caliper, the maximum allowable increase in caliper bore diameter is:
    A. 0.001 in (0.025 mm).
    B. 0.002 in (0.050 mm).
    C. 0.005 in (0.127 mm).
    D. 0.008 in (0.043 mm). (C.7)
41. While reassembling a brake caliper:
    A. The boot should be installed and seated, followed by the seal.
    B. Coat the piston seal and boot with clean brake fluid.
    C. Leave the piston dry and install it through the boot and seal until it bottoms.
    D. Plug the bleeder screw hole and the high pressure inlet while installing the piston. (C.8)



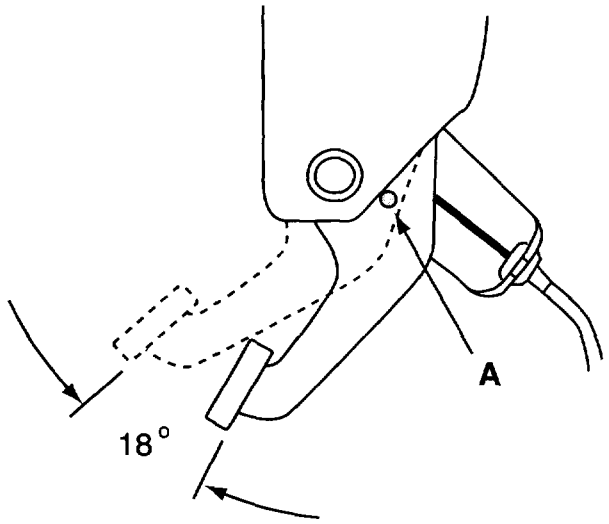
42. When discussing the brake rotor measurement in the figure above, Technician A says the brake rotor is being measured for run out. Technician B says this measurement should be made at three locations around the rotor. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (C.9)
43. When installing a new brake rotor: Technician A cleans any oil film from the surface of the rotor with solvent. Technician B does a finish cut on the rotor prior to installing it. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (C.10)
44. All of these statements about rotor machining are true EXCEPT:
    A. A vibration damper must be placed around the outside diameter of the rotor to prevent chatter marks.
    B. With fixed caliper rotors, unequal amounts of metal may be machined from each side of the rotor.
    C. Machine both sides of the rotor before removing it from the rotor lathe.
    D. Use a sanding pad to sand the rotor surfaces after machining is completed. (C.11)
45. While discussing brake pad installation, Technician A says the inboard and outboard brake pads are interchangeable in many calipers. Technician B says brake pad rattle may occur if there is any clearance between the pad retainer and the caliper retainer ledge. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (C.2)

46. When adjusting the parking brakes on a vehicle equipped with rear disc brakes:
    A. Do nothing because the parking brakes are self-adjusting.
    B. There should be 0.75 in (19 mm) of slack in the cables so they don't bind during application.
    C. The parking brake cable should be adjusted with the parking brake on one click so there will be a slight drag in the wheels.
    D. The parking brake cable should be adjusted so there is 0.50 in (1.27 mm) between the stopper pin and the stop. (C.13)
47. In most cast iron master cylinders, the distance from the brake fluid level to the top of the reservoir casting should be:
    A. 0 in (0 mm).
    B. 0.25 in (6.35 mm).
    C. 0.75 in (19 mm).
    D. 1.00 in (25.4 mm). (C.14)
48. While discussing wheel and lug nut installation, Technician A says excessive lug nut torque may cause rotor runout. Technician B says an impact wrench may be used to tighten lug nuts. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (C.15)
49. With the engine stopped, the technician pumps the brake pedal several times and then holds the brake pedal on and starts the engine. The pedal moves slightly downward when the engine is started. This action indicates:
    A. a restriction in the power booster vacuum hose.
    B. a defective check valve in the power booster vacuum hose.
    C. a normal vacuum supply to the power booster.
    D. a low intake manifold vacuum. (D.1)
50. While checking the vacuum supply to the power brake booster, Technician A says the vacuum gauge should be connected between the one-way check valve and the brake booster. Technician B says with the engine idling, the vacuum supplied to the brake booster should be 8 to 10 in Hg (74.4 to 67.6 kPa absolute). Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (D.2)
51. There is evidence of brake fluid leakage into the engine. The cause of the problem could be:
    A. a defective vacuum hose to the brake booster.
    B. a defective one-way check valve in the booster vacuum hose.
    C. a defective PCV valve with excessive restriction.
    D. a partially restricted air cleaner element. (D.3)

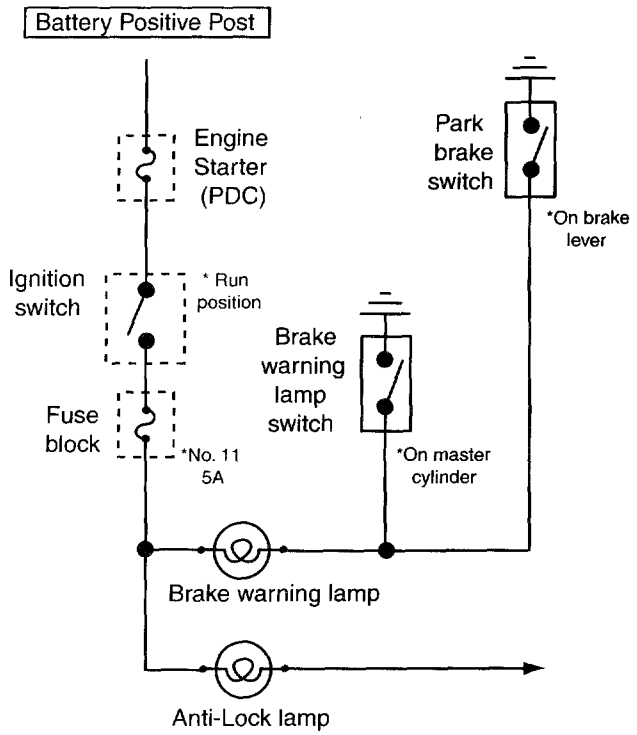
52. The power steering operates normally on a hydro-boost-equipped vehicle. During a hydro-boost brake test, the brake pedal is pumped several times with the engine not running. When medium pressure is applied to the brake pedal and the engine is started, the brake pedal height remains unchanged. Technician A says the power steering pump pressure may be low. Technician B says the accumulator may be defective in the hydro-boost unit. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (D.4)

53. A front-wheel-drive vehicle has tapered roller bearings in the rear wheel hubs. While adjusting the rear wheel bearings, the bearing adjustment nut is tightened to 25 ft. lbs. (33.9 Nm). The bearing nut should then be:
    A. loosened one turn and then tightened to 50 in. lb. (57.6 cm-kg).
    B. loosened one and one-half turn and tightened to 75 in. lb. (86.4 cm-kg).
    C. loosened one half turn and tightened to 10 to 15 in. lb. (11.5 to 17.3 cm-kg).
    D. loosened one half turn and tightened to 40 in. lb. (46.1 cm-kg). (E.2)

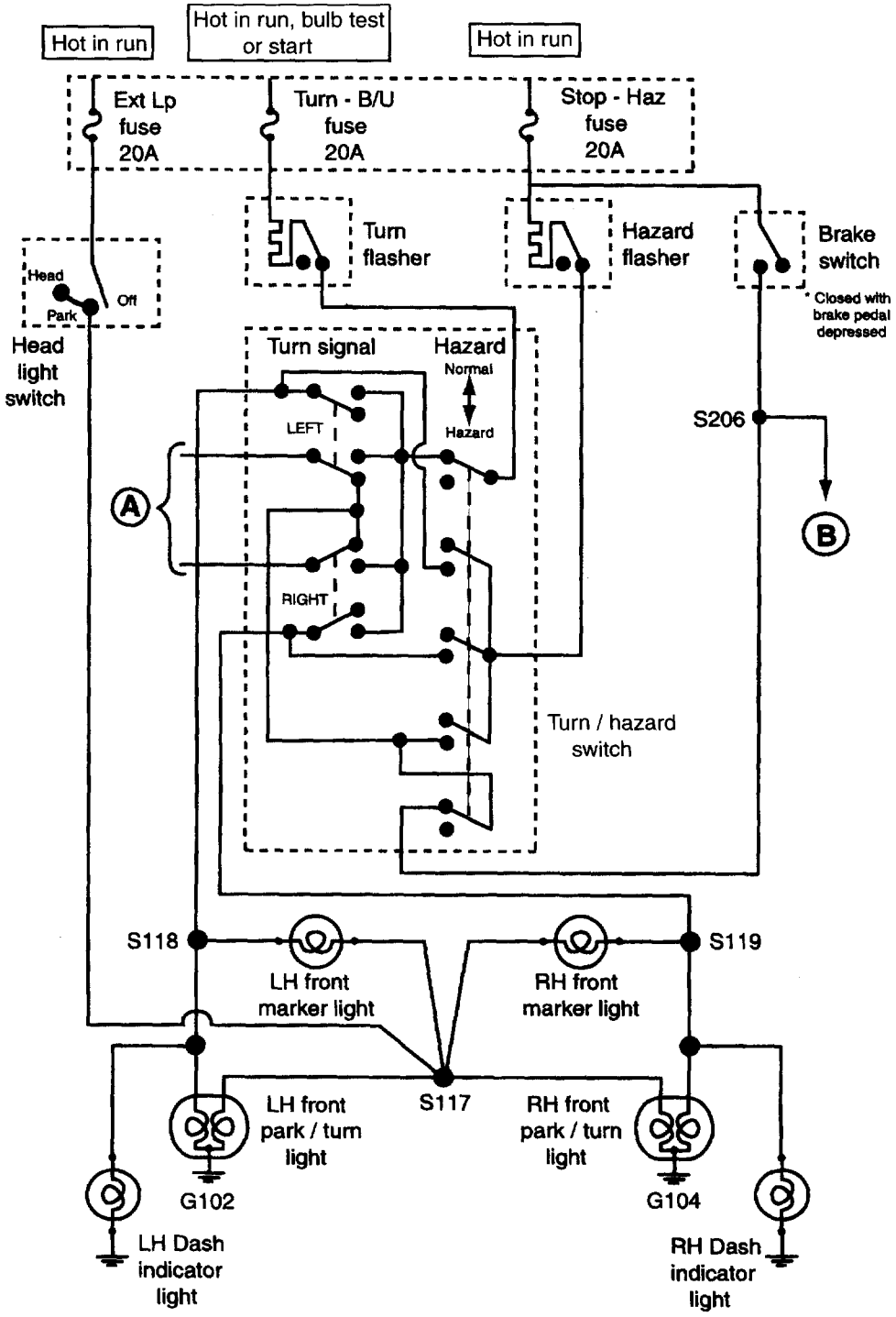
54. While discussing parking brake adjustments, Technician A says the brake shoes should be properly adjusted before the parking brake adjustment. Technician B says after the cable adjusting nut is tightened so the rear wheels have a slight drag, loosen the nut four turns. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (E.3)



55. In the figure what does the part labeled as "A" represent?
    A. The point of the parking brake pedal assembly that should be lubricated.
    B. The hole where a specified pin should be installed when the parking brake cable is adjusted.
    C. The mounting point for the parking brake lamp.
    D. The point at which the parking brake should be fully applied. (E.4)



56. The brake warning light is illuminated continually with the ignition switch on in the above figure. All of these defects may be the problem EXCEPT:
    A. an open circuit in the wire to the parking brake switch.
    B. the wire to the parking brake switch touching the vehicle ground.
    C. a continually closed parking brake switch.
    D. low fluid level in the secondary section of the master cylinder reservoir. (E.5)



57. When the brake pedal is depressed, the rear stoplights are not illuminated, but the high mount stoplight operates normally (see the preceding figures). The turn signals and hazard warning circuits operate normally. Technician A says the cause of this problem may be a blown stop-hazard fuse. Technician B says there may be an open circuit between Junction S206 and the turn signal switch. Who is right?

A. A only
B. B only
C. Both A and B
D. Neither A nor B (E.6)

58. While discussing ABS service, Technician A says the high-pressure accumulator must be discharged before a brake line is disconnected. Technician B says some manufacturers recommend relieving the accumulator gas pressure before accumulator disposal. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (F.1)

59. While road testing a vehicle with ABS, a clicking noise is heard for a short time when the engine is started and the vehicle starts off at low speed. During a normal stop when the ABS function is not operating, pedal pulsations are experienced. Technician A says the clicking noise may be caused by defective solenoids in the ABS hydraulic control unit. Technician B says the pedal pulsations are normal on an ABS system. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (F.2)

60. All of these conditions may cause illumination of the red brake warning light EXCEPT:
    A. parking brake engagement.
    B. low fluid level in the master cylinder.
    C. an open wheel speed sensor winding.
    D. an accumulator pressure below 1,500 psi. (F.3)

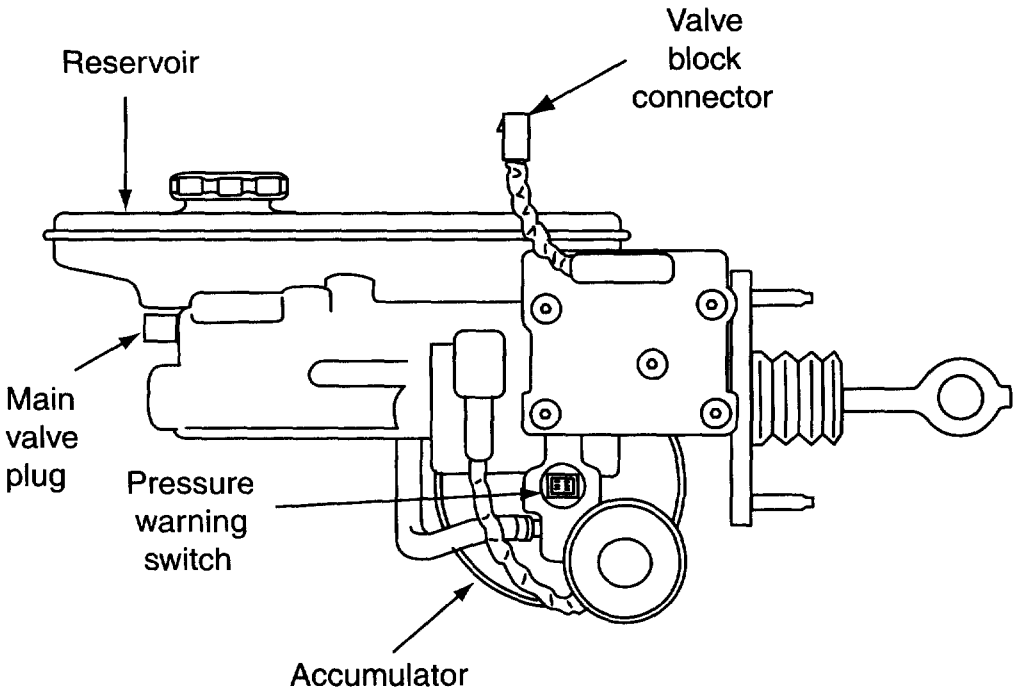
61. While discussing ABS trouble codes: Technician A says all vehicles with ABS provide a means to display flash codes. Technician B says the use of a larger tire may affect ABS operation but will not set a DTC. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (F.4)

62. On ABS systems with a high-pressure accumulator, the accumulator is depressurized by:
    A. pumping the brake pedal 25 times with the ignition switch off.
    B. pumping the brake pedal 10 times with the ignition switch on.
    C. loosening the bleeder screw on the accumulator with the ignition switch on.
    D. loosening the front wheel bleeder screws with the ignition switch on. (F.5)

63. On an integral ABS with a high-pressure accumulator, Technician A says the master cylinder fluid level should be checked with a discharged accumulator. Technician B says the master cylinder fluid level should be checked with the engine running and the brake pedal applied. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (F.6)

64. All of these statements about bleeding an ABS with a high-pressure accumulator are true EXCEPT:
    A. The front and rear brakes may be bled with a pressure bleeder.
    B. Be sure the ignition switch is on when using a pressure bleeder.
    C. Be sure the brake pedal is released when using a pressure bleeder.
    D. The rear brakes may be bled with a fully charged accumulator. (F.7)

65. On an integral ABS with a high-pressure accumulator, all of these statements about accumulator pressure and pump run time are true EXCEPT:
    A. If the accumulator pressure is low, the pump run time may be longer than specified.
    B. Low accumulator pressure has no effect on brake boost power.
    C. A defective pressure switch may cause higher than specified boost pressure.
    D. A pressure gauge and adapter may be installed between the accumulator and the accumulator fluid passage. (F.8)



66. When servicing the integral ABS unit with a high-pressure accumulator, as shown in the figure, Technician A says the accumulator pressure should be relieved before removing the solenoid valve body. Technician B says the accumulator pressure should be relieved before removing the reservoir. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (F.5)

67. A diagnostic trouble code (DTC) representing the L/R wheel speed sensor is obtained in the ABS. This DTC may be caused by:
    A. an open circuit at R/R wheel signal low connected to the ABS module.
    B. a grounded circuit on the L/R wheel signal low connected to the ABS module.
    C. a larger tire than specified by the manufacturer on the L/R wheel.
    D. an open circuit in the electronic brake control. (F.4)

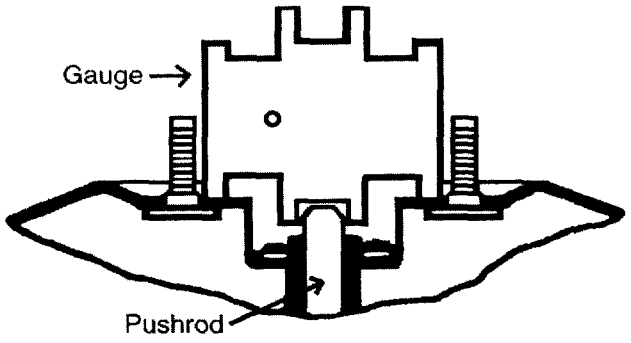
68. An ABS-equipped rear-wheel-drive vehicle experiences lockup on both rear wheels during the anti-lock brake mode. Technician A says larger than specified tires may be installed on the rear wheels. Technician B says the rear tires may not be the same size on each rear wheel. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (F.2)

6 Additional Test Questions for Practice

Additional Test Questions

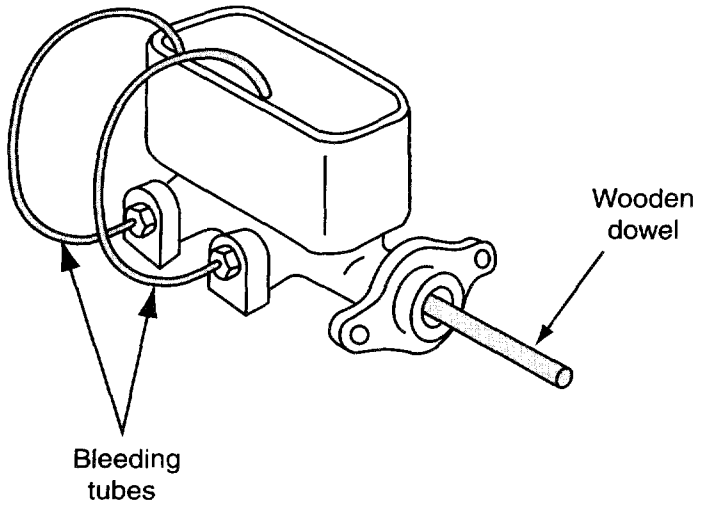
Please note the letter and number in parentheses following each question. They match the overview in section 4 that discusses the relevant subject matter. You may want to refer to the overview using this cross-referencing key to help with questions posing problems for you.

1. A customer complains that a brake pedal is hard to depress. Technician A says it could be a plugged master cylinder replenishing port. Technician B says it could be excessive clearance between the master cylinder push rod and the master cylinder piston. Who is right?
   A. A only
   B. B only
   C. Both A and B
   D. Neither A nor B (D.1)
2. A fast-fill valve is a valve assembly that provides brake fluid to what area?
   A. The reservoir
   B. The spool area of the secondary piston
   C. The spool area of the primary piston
   D. The master cylinder outlet port (A.1.2)



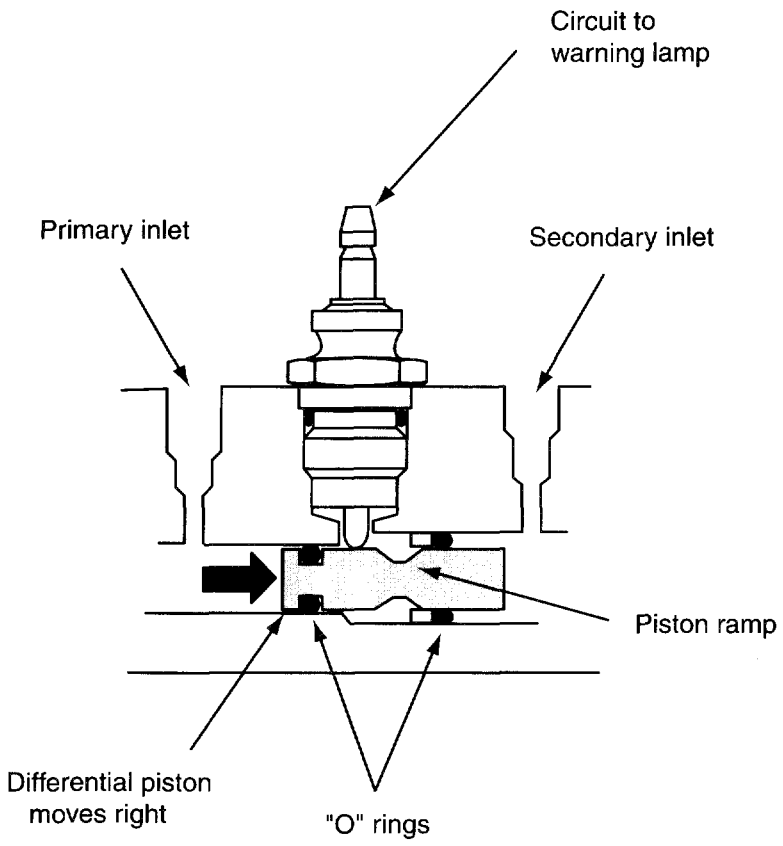
3. As shown, the vacuum booster pushrod length must be adjusted during all of the following repairs EXCEPT:
   A. brake shoe replacement.
   B. original assembly at the factory.
   C. master cylinder service.
   D. vacuum booster service. (A.1.3)

4. A customer is concerned that the brake pedal is easily depressed with little or no effect. Technician A says there could be air in the system and it should be bled. Technician B says it could be a leaking primary cup in the master cylinder. Who is right?
   A. A only
   B. B only
   C. Both A and B
   D. Neither A nor B (A.1.4)
5. While discussing master cylinder removal on a vehicle equipped with manual brakes, Technician A says there is no procedural difference between manual brakes and power brakes other than the brake booster. Technician B says the push rod must be disconnected from the brake pedal unlike a power brake system. Who is right?
   A. A only
   B. B only
   C. Both A and B
   D. Neither A nor B (A.1.6)



6. When bench bleeding a master cylinder using brake tubing, it is important that the ends of the tubes are submerged as shown in the figure because
   A. It allows you to retain the expelled fluid.
   B. It keeps the master cylinder cups from swelling.
   C. It prevents contamination of the brake fluid.
   D. It prevents air from being sucked back into the master cylinder. (A.1.7)
7. After installing a bench bled master cylinder, Technician A says the entire system should be bled. Technician B says the system is ready for operation because the lines were capped. Who is right?
   A. A only
   B. B only
   C. Both A and B
   D. Neither A nor B (A.1.6)

8. Which of the following is true about flare nuts?
   A. They are only used on double flared brake tubing.
   B. They are highly resistant to rust and corrosion.
   C. They have to be replaced if they are removed because they are torque-to-yield type fasteners.
   D. They are only available in conventional sizes. (A.2.2)
9. All of the following about brake hoses are true EXCEPT:
   A. Some caliper components and hoses may be reverse threaded.
   B. Most hoses are attached to the chassis and secured with a hose lock clip.
   C. Cleaning the ends of the hoses prior to removal will reduce the possibility of dirt entering the system.
   D. Replacement hoses can be longer than the original. (A.2.4)
10. Technician A says there are two types of brake line flares: double and single. Technician B says there is only one acceptable type of tubing flare: the ISO flare. Who is right?
   A. A only
   B. B only
   C. Both A and B
   D. Neither A nor B (A.2.4)
11. Which of the following is true about DOT 4 brake fluid?
   A. It's purple.
   B. It's compressible.
   C. It has a lower boiling point than DOT 3.
   D. It has a higher boiling point than DOT 3. (A.2.5)
12. Technician A says a proportioning valve is installed in the hydraulic line to the front brakes. Technician B says a metering valve is used with disc/drum brake systems to keep the front discs from operating until the rear drums have started to work. Who is right?
   A. A only
   B. B only
   C. Both A and B
   D. Neither A nor B (A.3.2)
13. A three-function combination valve combines the functions of:
   A. the brake failure light switch, the proportioning valve, and the metering valve.
   B. the brake failure light switch, the fast fill valve, and the metering valve.
   C. the load sensing proportioning valve, the fast fill valve, and the metering valve.
   D. the load sensing proportioning valve, the proportioning valve, the fast fill valve. (A.3.2)



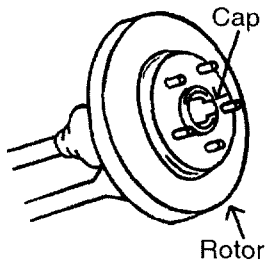
14. While testing a combination valve warning switch, as shown, the warning switch did not come on, but it does come on when a jumper wire is connected to a ground. Technician A says replace the valve. Technician B says the warning switch portion of the combination valve has malfunctioned. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (A.3.2)
15. When flushing a hydraulic system, Technician A says each bleeder screw is opened until all of the contaminated fluid is removed. Technician B says the fluid may be reused if it appears to be clean. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (A.4.1)
16. When pressure testing a power assist brake system with the engine running, the pedal should:
    A. be firm 0.5 in (12.7 mm) above the specified height.
    B. slowly sink after initial firm application.
    C. be firm at the specified pedal height.
    D. be firm 0.5 in (12.7 mm) below the specified pedal height. (D.1)

67. A diagnostic trouble code (DTC) representing the L/R wheel speed sensor is obtained in the ABS. This DTC may be caused by:
    A. an open circuit at R/R wheel signal low connected to the ABS module.
    B. a grounded circuit on the L/R wheel signal low connected to the ABS module.
    C. a larger tire than specified by the manufacturer on the L/R wheel.
    D. an open circuit in the electronic brake control. (F.4)

68. An ABS-equipped rear-wheel-drive vehicle experiences lockup on both rear wheels during the anti-lock brake mode. Technician A says larger than specified tires may be installed on the rear wheels. Technician B says the rear tires may not be the same size on each rear wheel. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (F.2)

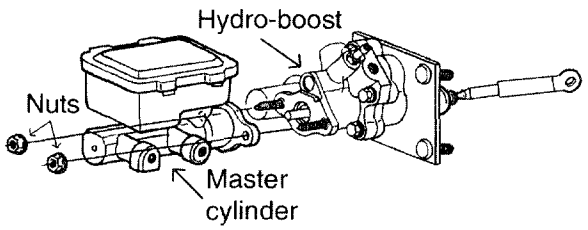
24. While discussing drum brake shoe installation, Technician A says the parking brake rear cable and conduit tension should be checked whenever the rear drum brakes are removed. Technician B says any good grease will be suitable for lubricating the backing plate shoe pads. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (B.5)
25. During installation, the brake shoes should:
    A. brush the brake drum when it is installed.
    B. be retracted fully to allow the drum plenty of clearance during installation.
    C. be adjusted to slightly less than the inside diameter of the drum.
    D. be lubricated to aid in drum installation. (B.8)
26. Self adjusting brakes:
    A. automatically adjust lining-to-drum clearances.
    B. automatically remove the slack from the parking brake cables.
    C. automatically compensate for a dragging drum brake.
    D. automatically adjust brake pad to rotor clearance. (B.9)
27. A restricted disc brake caliper hose could result in all of the following EXCEPT:
    A. dragging brakes.
    B. the vehicle will pull to that side under heavy braking.
    C. brake pedal pulsation.
    D. poor stopping. (B.2)
28. During an inspection of the disc brakes, the pads are observed to be worn to the backing pads. Technician A says the shoes will have to be replaced. Technician B says the rotor should be checked with a micrometer against the manufacturer's specifications. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (C.2)
29. Evidence of brake fluid around the caliper boot area indicates:
    A. an over-filled master cylinder.
    B. a bad caliper seal.
    C. restricted brake lines.
    D. worn caliper pins and bushings. (C.4)
30. A vehicle with a front/rear split brake system is being discussed. Technician A says when a caliper is found to be scored beyond repair due to contaminated fluid just the contaminated caliper should be replaced. Technician B says when a caliper is found to be unrepairable both calipers on that axle set should be replaced. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (C.7)

31. All of the following lubricants may be used when reassembling a brake caliper EXCEPT:
    A. silicone grease.
    B. rubber grease.
    C. the right brake fluid for the system.
    D. lithium grease. (C.8)
32. Brake rotors should be refinished under all of the following conditions EXCEPT:
    A. installation of a new brake rotor.
    B. failure of lateral runout or thickness variation checks.
    C. noticeable brake pulsation
    D. heat spots or slight scoring. (C.9)



33. A front brake rotor, shown in the figure, cannot be pulled off of the vehicle with the caliper positioned aside and the attaching hardware removed. Technician A says to apply penetrating fluid to the front and rear mating surfaces and then strike it between the studs with a rubber or plastic hammer. Technician B says to use a three-jaw puller. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (C.10)
34. Technician A says that regardless of the depth of the cut a brake rotor requires, it should be made in one pass. Technician B says the rotor should be sanded so it becomes directional in order to speed the seating of the brake pads. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (C.11)
35. After the brakes have been bled and the system refilled, the next thing that should be done is:
    A. Back off the drum brake star adjusters one full turn to avoid brake drag.
    B. Road test the vehicle.
    C. Pump the brakes several times and check for leaks.
    D. Move the vehicle back and forth several times applying the pedal hard to set the brake self-adjusters. (A.4.2)

36. During a final road test, all of the following will cause a pull while braking EXCEPT:
    A. mismatched tire pressure.
    B. contaminated brake linings.
    C. dragging parking brakes.
    D. a seized caliper piston. (C.1)
37. Technician A says weak power unit operation may be caused by leaking or collapsed vacuum lines. Technician B says weak power unit operation may be caused by insufficient manifold vacuum. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (D.3)
38. With the engine idling, the vacuum from the intake manifold to the brake booster is found to be below specification. The technician should then:
    A. Connect the vacuum gauge directly to the intake manifold.
    B. Conclude that the brake booster is faulty and rebuild it.
    C. Check the brake fluid level.
    D. Increase the engine rpm and recheck the vacuum. (D.3)
39. While testing the vacuum brake booster, the engine is operated for two minutes and then shut off. The brake pedal is then applied normally several times; the pedal goes down normally each time. Technician A says this indicates the booster is operating normally. Technician B says the one-way check valve is defective and should be replaced. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (D.1)



40. When the hydro-boost unit shown is found to be leaking after all of the fittings have been tightened, the unit must be replaced if the leak is from the:
    A. accumulator cap seal.
    B. input seal.
    C. spool valve seal.
    D. return port fitting seal. (D.4)
41. A rear-wheel-drive vehicle experiences a front wheel shimmy. All of the following could cause this EXCEPT:
    A. loose front wheel bearings.
    B. improper front wheel alignment.
    C. improperly balanced front wheels.
    D. a seized caliper. (C.1)

42. Technician A says after a bearing is repacked, it must be reinstalled in the same cone. Technician B says that it is acceptable to spin dry currently available bearings because they are superior to previous designs. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (E.2)
43. Technician A says plastic coated wire strand parking brake cables need periodic lubrication. Technician B says damage to the plastic coating will impair the smooth operation of the system. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (E.3)
44. Before adjusting the parking brakes, the technician should:
    A. Bleed the front brakes.
    B. Check the tire pressure.
    C. Visually inspect the system.
    D. Fill the master cylinder with clean brake fluid. (E.4)
45. Technician A says the parking brake indicator light goes out when the ignition switch is turned off. Technician B says the parking brake indicator light may also be used in some vehicles to indicate problems in the anti-lock brake system. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (E.5)
46. When diagnosing a stoplamp circuit with all stoplamp bulbs inoperative, the technician should start with:
    A. the bulbs in the stop lights.
    B. the wiring to the switch.
    C. the light sockets
    D. the fuse to the circuit. (E.6)
47. Technician A says most of the services done to the brakes of an anti-lock brake system are identical to those in a conventional system. Technician B says before servicing an anti-lock brake system, it is important to understand the basics of electrical and electronic troubleshooting. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D Neither A nor B (F.1)
48. Diagnosing ABS brake systems is being discussed. Technician A says the first thing to do is connect the test equipment to the data link connector. Technician B says the amber brake system light should not come on at all during a system self-test. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (F.3)

49. Technician A says in most cases an ammeter can be used to locate the exact cause of most ABS problems. Technician B says many ABS systems do not provide flash codes and the scan tool must be used. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (F.4)

50. A pressure gauge and adapter has been installed between the accumulator and the accumulator fluid outlet. The vehicle is then started. After the pump stops, the engine is stopped and a reading is taken and found to be below specifications. All of the following components should be checked EXCEPT:
    A. the pump relay.
    B. the pump.
    C. the pressure switch.
    D. the accumulator. (F.8)

51. After the DTCs have been retrieved for the ABS (and the problem has been fixed), the technician should shut off the engine and then:
    A. Disconnect the battery ground cable.
    B. Fill the master cylinder reservoir to specifications.
    C. Disconnect the brake booster vacuum hose to prevent accidental charging of the brake system.
    D. Set the parking brake. (F.4)

52. A wheel speed sensor and the connecting wires can be checked for an open circuit with:
    A. an ohmmeter.
    B. an ammeter.
    C. a voltmeter.
    D. a test light. (F.10)

53. Technician A says an improperly adjusted parking brake can cause the rear brakes to drag. Technician B says the parking brake equalizer balances braking force to each wheel. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (E.4)

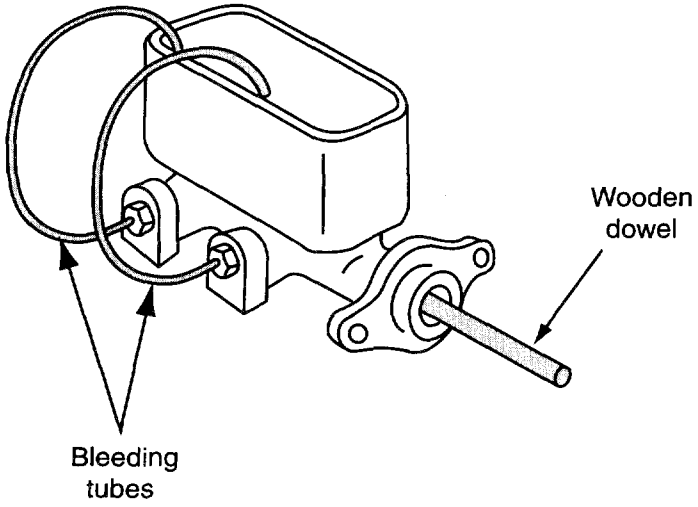
54. The flare on the end of a brake line has a bubble or chamfered shape. Technician A says this is a double flare. Technician B says this is an ISO flare. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (A.2.4)

55. Rotor serviceability is being discussed. Technician A says the minimum wear thickness of the rotor is the discard thickness of the rotor. Technician B says rotors should be refinished as part of routine disc brake service. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B. (C.9)

56. When determining if there is a problem with a given ABS component, Technician A performs the available component function test using the systems scanning tool. Technician B performs a visual inspection of the component. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (F.4)
57. The flexible wiring harness between the wheel sensor and the main harness that is mounted to the suspension is damaged. Several wires have snapped. Technician A uses solderless crimp connector and heat shrink tubing to repair the wires. Technician B uses solder and heat shrink tubing to repair the wires. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (F.4)
58. Brake linings are being discussed. Technician A says the last code marking on the lining edge, such as FE or GG, is a quality rating based on OSHA standards. Technician B says it is a code indicating the lining's coefficient of friction. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (B.7)
59. When testing for open replenishing ports in the master cylinder, Technician A says a small ripple or geyser should be seen when the brake pedal is released. Technician B says a small geyser in the master cylinder after the brake pedal is released indicates that air may be trapped in the system. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (A.1.4)
60. A constant pressure on the brake pedal results in the pedal drifting to the floor. No fluid leaks on external brake components can be seen. This could be caused by:
    A. an internal master cylinder leak.
    B. a crack on the master cylinder cap.
    C. a proportioning valve malfunction.
    D. a metering valve malfunction. (A.1.2)
61. On drum-type brakes, which of the following could cause a rising pedal on successive brake applications?
    A. Insufficient pedal free travel.
    B. Master cylinder piston seal leak.
    C. Brake shoes are reversed.
    D. Wheel cylinder pistons are sticking. (A.1.3)
62. Fluid drips on the carpet when the brake pedal is depressed. Which of the following is the cause?
    A. A defective master cylinder cup
    B. A torn input pushrod boot
    C. An overfilled master cylinder
    D. A leaking take up valve (A.1.5)

63. A vehicle is losing fluid from the master cylinder. There is brake fluid on the bulkhead (firewall). Technician A says that this could be caused by a defective secondary cup on the primary piston. Technician B says that this could be caused by a defective primary cup on the secondary piston. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (A.1.5)

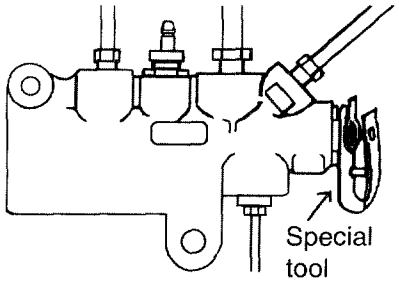
64. A master cylinder assembly is being removed from a vehicle with power assist. The technician should do all of the following EXCEPT:
    A. Relieve vacuum boost pressure.
    B. Plug the end of each brake line.
    C. Disconnect the negative battery cable.
    D. Remove the brake pedal push rod. (A.1.6)



65. Refer to the figure for the following question: Technician A says that both reservoirs must be filled. Technician B says that depressing the blunt end of the drift will remove air. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (A.1.7)

66. After new front pads have been installed and the calipers rebuilt, excessive pedal effort is needed to stop. This could be caused by:
    A. glazed front pads.
    B. air in the system.
    C. incorrect rear brake shoe return springs.
    D. a caliper piston sticking. (C.2)

67. When the brakes are firmly applied, the vehicle has a pull which is accompanied by a vibration. Which of the following could cause this condition?
    A. Collapsing strut rod bushings.
    B. Incorrect tire pressure.
    C. Contaminated brake shoes.
    D. Proportioning valve allowing too much hydraulic pressure to front brakes. (C.1)
68. Technician A says to replace the sealing washers when replacing the brake hose. Technician B says to replace the sealing washers each time the brake hose is removed from the caliper. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (A.2.4)
69. A brake line tube to a rear wheel cylinder needs replacing. Which of the following should be used as replacement tubing?
    A. Modified brake hose
    B. Double wall steel tubing
    C. Copper tubing
    D. Corrugated steel tubing (A.2.4)
70. The front end of a vehicle dips too much while braking lightly. Which of the following would be the cause?
    A. A bad master cylinder
    B. A bad metering valve
    C. A bad proportioning valve
    D. A bad vacuum check valve (A.3.2)
71. A car with a disc/drum system locks up during moderate braking. This could be caused by:
    A. a bad proportioning valve.
    B. a bad pressure differential valve.
    C. a bad metering valve.
    D. a bad height-sensing valve. (A.3.2)
72. The brakes on a vehicle equipped with a height sensing-type "P" valve must be bled. Technician A says to raise the vehicle and allow the axle to hang down. Technician B says to disconnect the rear shock absorbers. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (A.3.3)
73. The brake warning lamp circuit is being tested. The technician should do which of the following?
    A. ground the warning switch with the ignition off.
    B. ground the warning switch with the ignition on.
    C. apply battery voltage to the warning switch.
    D. apply battery voltage to the warning switch wire harness plug (A.3.4)

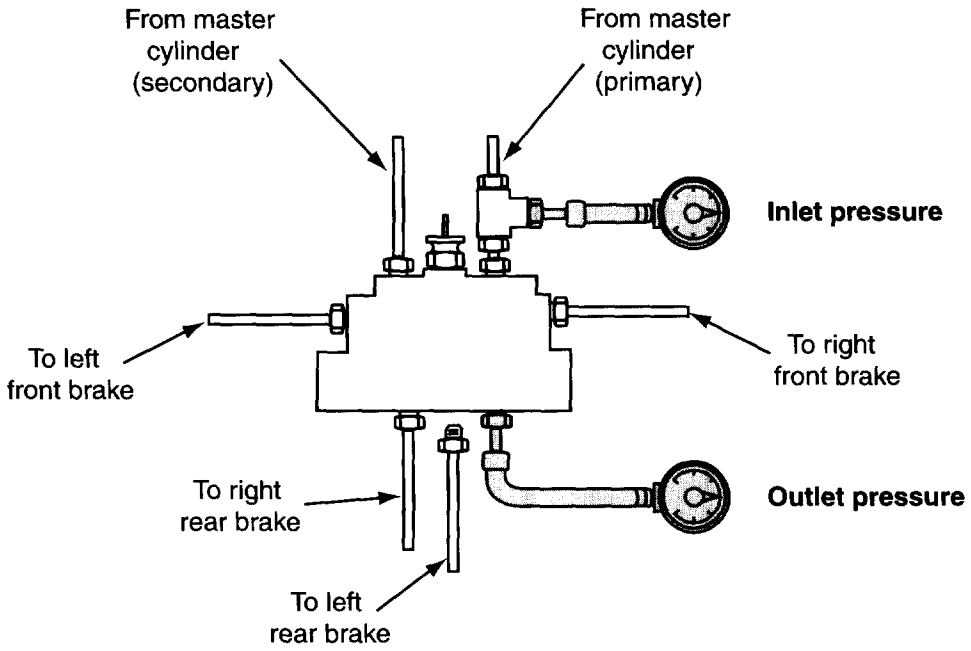


74. The special tool shown is used to:
    A. reset the brake warning light.
    B. hold the metering valve open.
    C. test the proportioning valve.
    D. adjust the bypass valve. (A.4.1)

75. Technician A says that vacuum bleeding pulls brake fluid from the brake system. Technician B says that vacuum bleeding pulls brake fluid from a container and then empties into brake system. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (A.4.1)

76. A manual bleeding procedure is being done to a vehicle with disc/drum brakes. If air is suspected in the master cylinder bore, which should be bled first?
    A. The rear wheel cylinders.
    B. The left front caliper.
    C. The height sensing proportioning valve.
    D. The master cylinder. (A.4.1)

77. Technician A says that surge bleeding can be used in addition to manual bleeding. Technician B says that surge bleeding can be used in addition to pressure bleeding. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (A.4.1)



78. In the figure, which component is being tested?
    A. A wheel cylinder
    B. A master cylinder quick take-up valve
    C. A proportioning valve
    D. A caliper (A.3.3)

79. A vehicle has drum brakes. Which of the following conditions is LEAST to cause vibration (chatter) during braking?
    A. Incorrect toe and heel clearance
    B. Hard spots on drum
    C. A loose backing plate
    D. A torn wheel cylinder boot (B.2)

80. When turning a drum, how much should be left under the discard size to allow for wear?
    A. .030 inch (0.67 mm)
    B. .060 inch (1.52 mm)
    C. .090 inch (2.29 mm)
    D. .110 inch (2.8 mm) (B.4)

81. A set of good brake linings becomes soaked with rear axle lubricant. Technician A says it is okay to wash the lining in solvent and reuse. Technician B says that it is okay to dry the lining with an oxy-acetylene torch and reuse it. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (B.5)

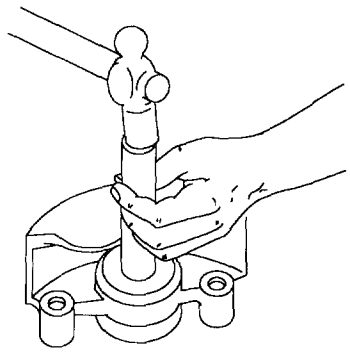
82. Which of the following should be used to clean the bores on wheel cylinders?
    A. Cleaning solvent
    B. Oil soap
    C. Hot water
    D. Isopropyl alcohol (B.5)

83. Brake shoes are being replaced on a car. Technician A says to lubricate the backing plate ledges (bosses). Technician B says to groove the backing plate ledges (bosses) to match the shoe arc. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (B.6)

84. Brake linings have just been replaced on a vehicle with disc/drum brakes and the brake pedal is high. This could be caused by:
    A. A misadjusted parking brake.
    B. Air in master cylinder bore.
    C. Brake drums were not resurfaced.
    D. Brake rotors were not resurfaced. (E.3)

85. A car with floating caliper disc brakes pulls to the right. This could be caused by:
    A. a frozen caliper.
    B. a bad proportioning valve.
    C. a seized master cylinder piston.
    D. excess brake fluid hydroscopicity. (C.2)

86. A FWD car owner complains of brake pedal pulsation. Technician A says this could be caused by loose front wheel bearings. Technician B says this could be caused by a worn outer constant velocity joint. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (C.2)



87. What operation is being performed in the figure?
    A. Installing a square-cut seal
    B. Installing a caliper piston
    C. Installing dust boot
    D. Honing the caliper bore (C.7)

88. A car with a disc/drum system pulls to the left when braking. Technician A says this could be caused by air bubbles in the left front caliper. Technician B says this could be caused by air bubbles in the right front caliper. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (C.1)

89. During a brake caliper rebuild, the best way to remove minor bore scratches is to use:
    A. Steel wool
    B. Crocus cloth
    C. A sanding disc
    D. A rounded file (C.8)

90. Technician A says to replace the guide pins when rebuilding a caliper. Technician B says to replace the piston seal when rebuilding a caliper. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (C.8)

91. Which of the following is generally used to check rotor parallelism?
    A. A straightedge
    B. A micrometer
    C. A dial indicator
    D. A weight scale (C.9)

92. Technician A says a brake rotor should be refinished if it fails a lateral runout check. Technician B says a brake rotor should be refinished if it fails a thickness variation check. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (C.9)

93. A rotor surface needs to be made nondirectional after resurfacing. Technician A says to use a power tool and a 120 grit aluminum oxide sanding disc. Technician B says to use a 150 grit aluminum oxide sanding block. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (C.11)

94. The parking brakes on a vehicle equipped with rear disc brakes need adjustment. Technician A says to fully release the parking brake. Technician B says to partially depress the parking brake. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (E.3)

95. A vehicle equipped with a disc/drum system has brake pedal pulsation. Lateral rotor runout is okay. This could be caused by:
    A. Incorrect tightening of the wheel lug nuts.
    B. Bulging flex-line hoses.
    C. A sticking master cylinder secondary piston.
    D. The installation of pads that are too hard. (C.2)

96. A vehicle with a Hydro-Boost system has reduced power brake assist. This could be caused by:
    A. a defective accumulator.
    B. glazed brake pads.
    C. sticking parking brake.
    D. incorrectly adjusted rear brakes. (D.4)

97. During the teardown phase of a brake job, the technician discovers the front wheel bearings are badly damaged as a result of too much end play. Which brake pedal complaint would have lead to the teardown?
    A. Spongy
    B. Hard
    C. Rising
    D. Pulsating (E.1)

98. Which of the following will not cause the brake warning light to come on?
    A. A shorted light circuit
    B. A worn master cylinder
    C. A leak in a brake line
    D. A torn caliper dust boot (E.5)

99. All of the following could cause the brake lights on a car to be inoperative EXCEPT a:
    A. bad ground at the sockets.
    B. bad flasher.
    C. bad directional switch.
    D. bad wire. (E.6)

100. A vehicle with ABS is brought in due to a pedal pulsation. Technician A says some pedal pulsation is normal during hard braking with ABS. Technician B says the brake rotors may have excessive runout. Who is right?
    A. A only
    B. B only
    C. Both A and B
    D. Neither A nor B (F.2)

7 Appendices

Answers to the Test Questions for the Sample Test Section 5

1. B	18. D	35. C	52. B
2. D	19. B	36. B	53. B
3. B	20. C	37. A	54. A
4. C	21. C	38. A	55. B
5. A	22. B	39. B	56. A
6. D	23. D	40. A	57. B
7. A	24. B	41. B	58. C
8. C	25. C	42. D	59. D
9. B	26. B	43. A	60. C
10. B	27. B	44. B	61. B
11. D	28. B	45. B	62. A
12. A	29. B	46. C	63. D
13. B	30. C	47. B	64. B
14. C	31. C	48. A	65. B
15. C	32. C	49. C	66. C
16. D	33. A	50. A	67. B
17. A	34. C	51. B	68. A

Explanations to the Answers for the Sample Test Section 5

1. Technician A is wrong. If fluid were leaking past the master cylinder cups, the brakes would feel spongy and would not grab. Technician B is right. A misadjusted stoplight or cruise control disable switch could cause the brakes to drag by preventing full release of the brakes. **The correct answer is B.**

2. **The correct answer is D.** Binding pedal linkage would cause a hard pedal and perhaps an effective brake system. This is also true for a dented brake line. A plugged compensator port may cause dragging brakes. A weak hydraulic brake hose could cause a spongy pedal. As the pressure builds in the system, the hose may expand and not relay the pressure to the brake units.

3. Answer A is wrong; free play would not affect pedal feel. Answer B is right. Without some free play, the brakes may not fully unapply and may cause brake dragging. Answer C is wrong; a spongy pedal is typically caused by air in the system. Answer D is also wrong. Leaking primary piston cups can cause a soft and/or low pedal and would not affect free play. **The correct answer is B.**

4. Both technicians are correct. If brake fluid leaks past the primary cups of the master cylinder, the pedal will slowly move downward after the brakes have been applied. The leaking cups would prevent high pressure buildup in the master cylinder. The same would happen if there were a small leak in one of the brake hoses or lines. **The correct answer is C.**

5. **The correct answer is A.** A leaking secondary cup on the primary piston could cause an external leak at the master cylinder. Because brake fluid tends to destroy paint, the peeling paint could be a good indication of a brake fluid leak. Answer B is wrong. Since the vacuum booster doesn't normally contain brake fluid, a diaphragm leak would only affect brake operation and would not cause a brake fluid leak. Answer C is also wrong. A leaking secondary cup on the secondary piston would not cause an external master cylinder leak. The leakage would be internal. Answer D is also wrong. If fuel were drawn into the booster, the booster would contain the fuel. Fuel also would not cause the paint to peel.

6. **Answer D is correct.** All of the answer choices need to be completed prior to removing the master cylinder. Draining the master cylinder of fluid is not something that must be done. If it is done, the fluid is removed only after the lines have been disconnected and capped. Fluid should not run out of the master cylinder while it's being removed so it is easier to empty the cylinder on a bench.

7. Only Technician A is correct. The only time the brake system needs to be bled is when the hydraulic system is opened or when air is present in the system. Many brake system repairs are done without the need to bleed the system afterwards. **The correct answer is A.**

8. Both technicians are right. Excessive pedal effort can be caused by a poor vacuum supply to the power brake booster and by a poorly adjusted brake pushrod. **The correct answer is C.**

9. The direction a vehicle pulls toward during the application of brakes is the side of the vehicle that has less braking power. If something on the right side were causing the brakes to drag or grab, the vehicle would tend to pull to the side with less braking power or the left side. Answer A would cause a pull to the right. Answer B would cause a pull to the left, and answers C and D would not cause a pull. **The correct answer is B.**

10. Whenever a brake line is damaged, it should be replaced. If a small section of the line is bad, a tube can be inserted to repair that spot. This tube and the connections, however, must be able to withstand high pressures and vibrations. Compression fittings do not allow for these. Whenever a brake line needs to be shaped or bent, a tool-bending tool should be used. Trying to form the line by hand may result in dents or kinks. **The correct answer is B.**

11. Both technicians are wrong. Sealing washers should always be replaced and not reused, regardless of condition. These washers distort and lose their sealing ability once tightened and loosened. If the male end of the fitting were tightened after the female end was tightened, the brake hose would twist as the fitting was turned. **The correct answer is D.**

12. Copper tubing should never be used in brake systems. Copper corrodes easily and can expand due to high pressures. Therefore, answer A is wrong. Brake system lines and hoses must be able to withstand vibrations, the environment, and high pressures. All of the other answers are right. This is an except-type question and the **correct answer is A** because it is wrong.

13. Silicone-based brake fluid is classified as DOT 5 fluid and is non-hygroscopic, which means it does not absorb water. DOT 3 and DOT 4 brake fluids are hygroscopic and will absorb moisture. **The correct answer is B.**

14. A metering valve is used on systems with front disc and rear drum brakes. During brake application, the fluid pressure must overcome the force of the brake shoe return springs and force the shoes outward. A little time is required to apply the rear drum brakes; therefore, the front disc brakes (which apply quickly) are slightly delayed during light brake applications so that both the front and rear brakes can be applied at the same time. **The correct answer is C.**

15. In the figure, the pressure gauges are connected to the input side of the valve and to the output for the rear brakes. When the brakes are applied, the proportioning valve decreases the pressure to the rear brakes during moderate brake applications. During the light applications, the pressure is unaffected by the valve. Under heavy pedal effort, the proportioning valve allows full fluid pressure to the rear brakes. Only answer C is correct; **the correct answer is C.**

16. Both technicians are wrong. The purpose of the load-sensing proportioning valve is to reduce brake pressure to the rear wheels as the vehicle lifts in relationship to the rear axle. The raising of the rear of the vehicle causes the vehicle's weight to be thrown forward, which increases the amount of braking force needed to stop the vehicle. By decreasing rear brake pressure, the vehicle will tend to remain flatter and the rear wheels will not as easily lock up. **The correct answer is D.**

17. **The correct answer is A.** Only Technician A is right. The brake system warning light comes on when there is a pressure difference on one side of the switch and is off when the pressure on both sides is equal.

18. All of the answers are wrong, except D. An easy way to check the operation of the brake warning light circuit is to disconnect the wire to the switch and temporarily ground it. If the circuit is fine, the lamp will light when grounded. This is what the switch should do when it is working normally. **The correct answer is D.**

19. Technician A is wrong; the metering valve should be held open during bleeding. Technician B is right. A pressure bleeder has two separated chambers, one for air and one for fluid. If the air and fluid mixed, there would be no point in bleeding the system, as air would be forced into the brake circuits. **The correct answer is B.**

20. All of the statements in this question are true or correct, except C. The fluid in the reservoir should never drop below the halfway point. A level lower than that could allow air to enter the system. Because it is wrong, **the correct answer is C.**

21. All of the statements in this question are true or correct, except C. If the bleeder screw is left open when the pedal is released and moves up, air will be drawn through the valve and enter the system. C is wrong, but **the correct answer is C,** for this except-type question.

22. In order to move the air that may be trapped in the brake system, pressure must be built up to force the air out when the system is opened. This is the process described by answer B. The other answers relate to pressure bleeding, not surge bleeding, or would allow air to enter the system during the bleeding process. **The correct answer is B.**

23. When pressure testing a hydraulic brake system equipped with a metering valve and a proportioning valve, the pressure at the master cylinder outlet should exceed the pressure at the rear wheel brakes. **The correct answer is D.**

24. A springy and spongy pedal is caused by air in the hydraulic system. Therefore Technician B is right. Plugged vents in the master cylinder cover would not allow air into the system and Technician A is wrong. **The correct answer is B.**

25. **The correct answer is C;** both technicians are right. Brake squeal may be caused by bent backing plates, distorted drums, loose linings, improper position of the linings on the shoes, weak or broken hold down springs, or loose wheel bearings.

26. In this except-type question, all of the statements are true except B. If the inside diameter of a drum is less than specifications, it should not be replaced. In fact it is fine providing the shoes fit inside the diameter. **The correct answer is B.**

27. While machining a brake drum a rough cut of 0.005 to 0.010 inches is recommended. The finish cut should be 0.005 inches or less. **The correct answer is B.**

28. Technician A is wrong. Part 17 is the parking brake strut. This strut pushes the leading brake shoe into the drum. If this part were omitted, the parking brakes would not function properly. Part 8 is the self-adjusting actuator cable. If this was omitted, the brake would not self-adjust. **The correct answer is B.**

29. Technician A is wrong. Brake grabbing would not usually be caused by a bent backing plate. This problem normally causes brake squeal or other noises. Technician B is right. Brake chatter may be caused by improper brake adjustment; loose backing plates; contaminated brake linings; out-of-round, tapered, or bell-mouthed drums; cocked or distorted shoes; or loose wheel bearings. **The correct answer is B.**

30. **The correct answer is C.** When serving a wheel cylinder, always lubricate the piston cups with clean brake fluid before installing them. Brake parts should be cleaned with denatured alcohol, not soap and water. If the cylinder bore is deeply pitted or scored, it should be replaced. Attempting to hone the defects away will result in an oversized bore, one in which the cups may not seal. During assembly, the flat side of the pistons should face the inside of the cylinder.

31. Both technicians are correct. The shoe ledges on the backing plate should be lubricated and if they are dry, a squeaking noise may be heard during brake application. If the shoe ledges are slightly scored, they can be filed down and sanded smooth, then a fresh coat of lubricant should be applied. **The correct answer is C.**

32. **The correct answer is C.** While assembling the brake shoes and related hardware, make sure the adjuster is installed in the correct direction. The other answer choices are wrong. The secondary shoe should face toward the rear of the vehicle, not the front. The primary and secondary shoe return springs are not interchangeable. And, the adjuster cable is usually mounted on the secondary shoe, not the primary.

33. Technician A is right. The tool is being used to match the width of the brake shoes to the inside diameter of the brake drum. Technician B is wrong; this tool is not used for measuring shoe wear. **The correct answer is A.**

34. When making final adjustments on the drum brakes, the star adjuster should be adjusted until there is a slight drag on the drum and then backed off until the wheel spins freely. **The correct answer is C.**

35. All of the answers may cause a vehicle to pull to one side during braking, except answer C. A seized master cylinder piston would not affect side-to-side braking and would not cause pulling. **The correct answer is C.**

36. Technician A is wrong. A worn outer CV-joint would not cause a brake pedal pulsation. It will typically cause a noise when the vehicle drives through a turn. Technician B is correct. A loose front wheel bearing is a likely cause for pedal pulsation during braking. **The correct answer is B.**

37. This is a theory-based question and **the correct answer is A.** The relaxing of the seal and the contact of the piston on the rotor causes the piston to recede after the brake pedal has been released.

38. When the outer brake pad of a floating caliper-type disc brake has very little wear but the inner pad has much, a likely cause is answer A: worn caliper pins and bushings. The other answers would not cause this problem. One pad wears more because the caliper is not free to move evenly as it tries to squeeze the pad onto the rotor. **The correct answer is A.**

39. The scraping noise described in this question is known as an audible warning. The noise is designed to alert the driver of worn brake pads. Once the pads wear enough, a metal projection on the pad contacts the rotor and makes the noise when the brakes are applied. **The correct answer is B.**

40. A caliper bore should never be increased by more than 0.001-inch. Any more than that may allow the piston to move on an angle and get stuck in the bore. **The correct answer is A.**

41. While assembling a brake caliper, coat the piston seal and boot with clean brake fluid. **The correct answer is B.** Do not attempt to install the seal after the boot has been installed. Also do not attempt to install a dry piston through the boot. Answer D is also wrong. If the bleeder screw hole is plugged while you attempt to install the piston, you will need to compress the air in the cylinder while pushing the piston in. An open bleeder screw allows the air to be pushed out of the way as the piston is being installed.

42. A rotor should be checked for thickness and parallelism with a micrometer. The figure for this question shows a micrometer taking a thickness measurement. Overall thickness will determine if the rotor can be re-used. Making this measurement every 45 degrees will determine if the rotor is parallel or not. In this question, both technicians are wrong and **the correct answer is D.**

43. When installing new brake rotors, most manuals caution against refinishing the surfaces as these are already at the correct level of surface finish. Making even a light cut on a new rotor may produce excessive lateral runout. New rotors are often covered with an oil to stop them from rusting while they sit on the shelf in a parts store. This oil must be cleaned off before installation. Normally a good clean solvent will do the trick. **The correct answer is A.**

44. All of the statements of this except-type question are true except B. Both sides of the rotor should always be machined evenly, regardless of the type of caliper assembly. **The correct answer is B.**

45. **The correct answer is B.** The inboard and outboard brake pads are not interchangeable on most calipers. If there is clearance between the pad retainer and the caliper retainer ledge, brake pad rattle may occur. Only Technician B is right.

46. When adjusting the parking brakes on a vehicle equipped with rear disc brakes, the parking brake cable should be adjusted with the parking brake on one click so there is a slight drag in the wheels. The other answers are wrong. The parking brake is not self-adjusting. There is not a specification for cable slack at any point in the system. **The correct answer is C.**

47. On most cast iron master cylinders, the brake fluid level should be 0.25 inch (6.35 mm) below the top of the casting surface. **The correct answer is B.**

48. An impact wrench should never be used to tighten bolts; this includes lug nuts. Technician B is wrong. Technician A is right; excessive lug nut torque can cause rotor runout. **The correct answer is A.**

49. A common way to check the action of a vacuum power brake booster is to check the brake pedal movement when the engine off. With the engine off, pump the brake pedal several times and hold the pedal in the applied position. When the engine is started, the pedal should move slightly downward. This is normal and indicates a normal supply of vacuum to the booster. **The correct answer is C.** The other answers are wrong. A is wrong because this does not indicate a restriction in the power booster hose. A restriction would cause a hard pedal and extra effort to stop the vehicle. B is wrong; a defective check valve would cause the same problem. And, D is wrong because low vacuum would not allow the booster to react and the pedal would stay in the same position whether the engine was off or on.

50. To check the vacuum supply to the booster, the vacuum gauge should be installed between the one-way check valve and the brake booster. With the engine idling, the vacuum should be 16 to 18 in Hg (47.4 to 40.6 kPa). Only Technician A is right and **the correct answer is A.**

51. **The correct answer is B.** A is wrong because a defective hose would not allow brake fluid to enter the engine. C is wrong because the PCV valve vents the engine's crankcase of blowby gases and has nothing to do with the brake system. D is also wrong; the air cleaner could in no way affect or cause a brake fluid leak. Only answer B is right.

52. Technician A is wrong. If the pump were defective, the power steering would also not function properly. Technician B is right. The accumulator in the hydro-boost unit may be defective. **The correct answer is B.**

53. **The correct answer is B;** the bearing nut should be tightened to 25 pounds, then loosened one and one-half turns and retightened to 75 pounds.

54. **Technician A is right.** The brake shoes should be properly adjusted before making an adjustment to the parking brakes. Technician B is wrong; this would provide for too much cable slack.

55. During parking brake adjustment, some vehicles have a hole in the parking pedal mechanism that will accept a specified pin. The parking brake should be applied until the pin contacts the outer flange on the pedal assembly before the cable is adjusted. **The correct answer is B.**

56. In this except-type question, only answer A is wrong. An open in either circuit would not provide the necessary ground to illuminate the lamp. Since the problem is continuous illumination of the lamp, A cannot be right and **the correct answer is A.**

57. Technician A is wrong because a blown stop-hazard fuse would prevent the hazard lights and the center high mount stop lamp from working. The question states that these work normally. Technician B is right. The problem may be an open circuit in the turn signal circuit below junction S206. **The correct answer is B.**

58. Both technicians are right. A high-pressure accumulator in an ABS vehicle must be discharged before a brake line or any brake component is disconnected. Some manufacturers recommend relieving the accumulator pressure before discarding the accumulator. **The correct answer is C.**

59. Both technicians are wrong. The clicking noise during initial driving is a result of the ABS computer prove-out mode in which the computer momentarily energizes the solenoid in the ABS system. On many systems, pedal pulsations are normal during ABS function; however, pedal pulsations should not be evident during normal braking. **The correct answer is D.**

60. An applied parking brake, low fluid level, or low accumulator pressure may cause the red brake warning lamp to turn on. The amber ABS lamp will come on when there is a fault in the ABS, such as a bad wheel sensor. Therefore answer C is not true and in this except-type question, **the correct is C.**

61. Only Technician B is right. Many ABSs do not provide flash codes, and the DTCs must be obtained with a scan tool. The use of larger tires than specified may affect the ABS operation, but it does not result in setting a diagnostic trouble code (DTC). **The correct answer is B.**

62. Answer A is the most correct choice. On an ABS with a high-pressure accumulator, the accumulator is typically depressurized by pumping the brake pedal 25 times with the ignition switch off. Loosening or opening any part of the hydraulic system can be dangerous because the fluid is under the high pressure of the accumulator. **The correct answer is A.**

63. In an integral ABS with a high-pressure accumulator, the brake fluid level should be checked with a fully charged accumulator. Both technicians are wrong and **the correct answer is D.**

64. In this except-type question, answer B is the exception. The ignition switch does not need to be on while bleeding the brakes. All other answers are right and **the correct answer is B.**

65. All of the statements in this question are true, except B. Low accumulator pressure will decrease boost power. **The correct answer is B.**

66. Both Technicians are right, and **the correct answer is C.** Accumulator pressure should be relieved before any part of the ABS system is disconnected.

67. A DTC that indicates a faulty L/R wheel speed sensor indicates the problem is in that circuit and that circuit alone. Only one answer choice is related to that wheel's circuit, choice B. Although C is related to that wheel, a larger than normal tire or wheel would not set a code. It would, however, affect ABS operation since the larger tire would rotate at a slower speed. The other answer choices are not specific to the L/R wheel. **The correct answer is B.**

68. In this question, both rear wheels are locking up; therefore the problem must be something that is common to both rear wheels or something that the rear wheels have in common. The statement by Technician A meets that criteria and it is correct. Technician B is wrong because the odd-sized tires/wheels would cause a problem on only one side of the vehicle. **The correct answer is A.**

Explanations to the Test Questions for the Additional Test Questions Section 6

1. Only Technician A is correct. A plugged replenishing port will cause a hard pedal. Technician B is wrong; excessive clearance between the master cylinder push rod and the master cylinder would not cause a hard pedal or braking effort. **The correct answer is A.**

2. Answer A is wrong; the purpose of the fast-fill valve is to rapidly fill the spool area of the primary piston with fluid from the reservoir. B is also wrong. The fast-fill valve is located between the primary piston and the reservoir. Answer C is correct. The spool area of the secondary piston is the area that is provided fluid by the fast-fill valve. Answer D is wrong. **The correct answer is C.**

3. The vacuum booster pushrod length must be adjusted during the original assembly at the factory by the manufacturer, master cylinder service, and vacuum booster service. It is not of concern when you are replacing brake shoes; therefore, answer choice A is wrong and **A is the correct answer.**

4. Both technicians are correct. Both of these problems could cause the concern and both should be checked. **The correct answer is C.**

5. Technician A is wrong; in some vehicles that have power brake system master cylinders, the vacuum valve from the booster must be removed and the pressure warning switch connector disconnected before lifting off the master cylinder. Technician B is right. In vehicles that have manual brake system master cylinders, the pushrod must be disconnected from the brake pedal before the master cylinder can be removed. **The correct answer is B.**

6. The reason for making sure the tubes remain submerged during bench bleeding a master cylinder is simply to prevent the tubes from drawing in air as the pistons of the master cylinder are being moved. **The correct answer is D.**

7. All bench bleeding accomplishes is the removal of air from the master cylinder. Therefore it is possible that the system has air in it. In fact, it probably does even though the lines were capped. It is impossible to disconnect the lines and avoid letting some air in. Only Technician A is right and **the correct answer is A.**

8. There is only one valid statement in this question; choice B. Flare nuts are highly resistant to rust and corrosion. The other statements are wrong. **The correct answer is B.**

9. This is an except-type question. All of the statements are true except choice D and **the correct answer is D.** Replacement hoses should always match the size of the original equipment.

10. Both technicians are wrong. The double flare and ISO flare are only used in brake line fabrication. Single flares are never used in brake line work. The double flare can also be used in brake line fabrication. **The correct answer is D.**

11. The primary difference between DOT 3 and DOT 4 brake fluid is their boiling points. Answer D is right; DOT 4 has a higher boiling point than DOT 3. **The correct answer is D.**

12. Technician A is wrong. A proportioning valve is a brake system valve that maintains the correct proportion between the front and rear brake lines to provide a balanced vehicle braking system. Technician B is right; a metering valve is used with disc/drum brake systems to keep the front brakes from operating until the rear brakes have time to apply. **The correct answer is B.**

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13. Only answer A is right. The three-function combination valve combines the functions of the brake failure light switch, the proportioning valve, and the metering valve. **The correct answer is A.**

14. Both are correct. Since the combination valve contains all of the units to accomplish all of its tasks, the unit is replaced as a whole and is not rebuilt. The bottom line is that the valve needs to be replaced even if it is just the switch portion that is bad. **The correct answer is C.**

15. Only Technician A is right. Technician B is wrong. Brake fluid should never be reused. **The correct answer is A.**

16. When pressure testing a power assist brake system with the engine running, the pedal should be firm and at the specified height. **The correct answer is C.**

17. Mismatched tire sizes will not cause brake drag. This will cause other problems, but not drag; therefore answer choice B is wrong. The other answer choices are correct and **the correct answer is B.**

18. Reduced stopping ability can be caused by mechanical brake problems such as an improper brake adjustment; incorrect, glazed, or oil soaked linings; seized wheel cylinder pistons; or bell-mouthed, barrel-shaped or scored brake drums. Technician A is wrong; the problem may be the brake shoes and probably not the tires. Technician B is right. **The correct answer is B.**

19. Cone-shaped brake drums cause excessive inner or outer brake shoe lining, not pedal pulsation. Brake shoes that are worn beyond specifications cause a grinding noise, not pulsations. Low brake fluid can cause excessive stopping distances, but again not pedal pulsations. **The correct answer is D.**

20. Of the answers, only answer D is correct. After refinishing a brake drum the surface should be cleaned by wet washing with warm water and wiping it dry with a lint-free rag. The other choices suggest either unsafe or ineffective ways to clean the residue. **The correct answer is D.**

21. A blue coloring on a brake shoe indicates that the shoe has been overheated. **The correct answer is D.** Answer A is wrong; fluid contamination will cause an oil build up on the brake shoe. Answer B is wrong. A brake drum beyond its wear limits will warp. Answer C is wrong. A normal brake drum wear condition will not cause the shoes to be blue.

22. Both technicians are wrong. Linings that are covered with grease, oil, or brake fluid cannot be cleaned or reused. Also, brake assembly must be replaced in pairs. **The correct answer is D.**

23. Sometimes it is suggested to replace wheel cylinder when they are bad, just like Technician A said. But these units can be rebuilt. Replacement is recommended because of the time and risk involved in rebuilding one. Technician B is correct. It is normal for a small amount of brake fluid to leak around the piston for lubrication. **The correct answer is B.**

24. Technician A is right; the parking brake assembly should be checked whenever the rear drum brakes are removed. Technician B, however, is wrong. The backing plate shoe pads should never be greased. The ledges of the brake shoes that are positioned against the backing plates should be lubricated with high-temperature grease recommended by the manufacturer. **The correct answer is A.**

25. **The correct answer is C.** During installation, brake shoes should be adjusted to slightly less than the inside diameter of the drum. Answer choice A may allow dirt to get into the drum or onto the shoes. Choice B would force the technician to do some serious brake adjusting after the drum is installed, and D would render the brakes useless.

26. Self-adjusting brakes automatically adjust lining-to-drum clearance. **The correct answer is A.** B is wrong because the self-adjusters do nothing to the parking brake cable. C is wrong because the self-adjuster moves the shoes closer to the drum, not away from it. D is wrong because self-adjusters are only used on brake drum systems.

27. **The correct answer is C.** A restricted disc brake caliper hose would not cause pedal pulsation. Pulsation is caused by something being loose or by an unparallel rotor. The other answer are true statements.

28. Both technicians are right. If the pads are worn to their backing plates, the pads should be replaced and the rotor checked for excessive wear, parallelism, and scoring. **The correct answer is C.**

29. The only answer that would cause a fluid residue around the caliper bore area is choice B, a bad caliper seal. An over-filled master cylinder would leak fluid at the reservoir. A restricted brake line would not cause a fluid leak nor would worn caliper pins and bushings. **The correct answer is B.**

30. Technician A is wrong; if a caliper is scored beyond repair due to contaminated fluid the entire system should be inspected and flushed. If the fluid damaged one bore, it could have damaged them all. Technician B is correct. Calipers should be replaced in pairs. **The correct answer is B.**

31. Lithium grease is only used to lubricate mechanical interference points. It is not recommended for rebuilding a brake caliper. The other greases listed in the questions may be appropriate; always follow the recommendations of the manufacturer. **The correct answer is D.**

32. New brake rotors should not be refinished; therefore answer A is wrong. However, because this is an except-type question, **the correct answer is A.** Rotors should be refinished when there is lateral runout, thickness variation, pedal pulsations, heat spots, and light scoring.

33. Both technicians are right. If a rotor is difficult to remove, penetrating oil can be sprayed onto the front and rear mating surfaces and the rotor knocked off with a soft-tipped mallet. If penetrating fluid gets on the rotor, the rotor must be replaced. Another acceptable way to remove a rotor is with a three-jaw puller. **The correct answer is C.**

34. Both technicians are wrong. Each pass on the lathe should remove no more than 0.015 in. (0.381 mm). If more metal must be removed, then two or more shallow cuts are needed. Sanding the rotors accomplishes little. **The correct answer is D.**

35. After the brakes have been bled and the system refilled, the next thing that should be done is road test the vehicle. Bleeding should only be done after everything is installed and adjusted. **The correct answer is C.**

36. Dragging parking brakes will not cause the vehicle to pull unless the rear brakes are unevenly adjusted. This is a function of drum brake adjustment, not parking brake adjustment. Also rear wheels or brakes seldom will cause a vehicle to pull to one side. The other answers would. **The correct answer is C.**

37. Both technicians are correct and **the correct answer is C.** Weak power unit operation may be caused by leaking or collapsed vacuum lines and by insufficient manifold vacuum.

38. With the engine idling, if the vacuum from the intake manifold to the brake booster is found to be low, vacuum at the manifold should be measured before further testing and before replacing any parts. **The correct answer is A.**

39. Both technicians are wrong and **the correct answer is D.** Technician A is wrong because after pumping the brakes with the engine off, the brake pedal effort should be harder. Technician B is wrong because the one-way check valve has the purpose of keeping vacuum in the booster. The problem seems to be low vacuum at the booster.

40. All of the answers can be replaced individually at the outside of the unit, except for answer D. The return port fitting seal is internal and to repair it, the unit must be disassembled. Normally these units are replaced rather than repaired so answer D is right and **the correct answer is D.**

41. Answer A is right. A loose front wheel bearing will cause the vehicle to shimmy. Choice B is also right. An improper front wheel alignment will also cause the vehicle to shimmy. Answer C is also right; improperly balanced front wheels will cause the vehicle to shimmy. The only answer choice that is wrong is D and **the correct answer is D.**

42. Technician A is right; after a bearing is repacked it must be reinstalled in the same bearing cup and cone. Technician B is wrong. Never spin dry a bearing with air. This is a very dangerous practice. **The correct answer is A.**

43. Technician A is wrong. Plastic coated cables do not require periodic lubrication. Technician B is right; damage to the plastic coating can cause the cable to malfunction. **The correct answer is B.**

44. **The correct answer is C.** Before adjusting the parking brakes, the entire system should be inspected. There is no need to try to adjust the cables if they are broken, damaged, or kinked.

45. The red brake warning light comes on for a few seconds when the ignition key is turned on and is turned off when the ignition is turned off regardless of conditions. The warning light informs the driver of brake system failures, such as the parking brake being on, uneven hydraulic pressures which may indicate a leak, and low ABS accumulator pressure. Both technicians are right and **the correct answer is C.**

46. Inoperative stop lamps can be caused by several things. The best way to diagnose the problem is to think about it. If all the lamps do not light, it is very unlikely that the problem is burned out bulbs. The cause of the problem must be something that is common to all stop lamps. This is exactly what answer choice D suggests. The fuse is common to all lamps and would be the most logical place to begin diagnosis. **The correct answer is D.**

47. Both technicians are right. Most brake services done to ABS vehicles are the same as done to non-ABS vehicles. When diagnosing the ABS part of the system, a technician should have a good understanding of electricity and electronics. **The correct answer is C.**

48. Both technicians are wrong. Technician A is wrong. ABS systems have their own self-test by turning the ignition to the RUN position and observing the amber ABS and red brake warning indicators to see if the module is receiving a fault. Technician B is also wrong. The amber ABS light should prove out for approximately three to six seconds and then go out. If the amber ABS light does not go out, the module has found a fault in the system. **The correct answer is D.**

49. Technician A is wrong; most specifications do not include amperage readings. Therefore an ammeter would be useless unless those amperage values are known. Technician B is right; many late-model ABS vehicles do not display flash codes, and a scan tool must be used to retrieve DTCs. **The correct answer is B.**

50. **The correct answer is A.** This is the exception to the question and it is really untrue. The pump relay has no effect on the amount of pressure that is in the system. Answer B is true; the pump controls the amount of pressure that is in the system. Answer C is also true; the pressure switch controls the amount of pressure that is in the system. Answer D is also true; the accumulator controls the amount of pressure that is in the system.

51. After the DTCs have been retrieved for the ABS and the problem has been fixed, a technician should shut the engine off and disconnect the battery cable. This erases the DTCs from the computer. On some systems and scan tools, the DTCs can be erased through the scan tool. **The correct answer is A.**

52. A wheel speed sensor can be checked for an open with an ohmmeter, which is answer A. The other electrical test instruments can lead you to the suspicion of an open but will not pinpoint the problem. **The correct answer is A.**

53. Both technicians are correct and **the correct answer is C.** An improperly adjusted parking brake can cause the rear brakes to drag. Also, the parking brake equalizer balances braking force to each wheel.

54. The description of the flare in the question is called an ISO flare, not a double flare. **The correct answer is B.**

55. Technician A is correct. If the rotor has reached the minimum wear thickness, it cannot be refinished any further. Technician B is wrong. The rotor is only refinished when failing a run-out test, noticeable brake pulsation, heat spots, or scoring. **The correct answer is A.**

56. Both technicians are right. When determining if there is a problem with an ABS component, a scan tool can be used to monitor the component's activity and a careful inspection might locate a faulty part. **The correct answer is C.**

57. Neither technician is correct. Wheel speed sensor jumper harnesses are not repairable and must be replaced if they are damaged. **The correct answer is D.**

58. The markings on the side of brake shoe linings indicate the lining's coefficient of friction, just as Technician B said. The markings are not a measure of quality, as one would suppose. **The correct answer is B.**

59. Both technicians are right and **the correct answer is C.** A small geyser of fluid in the master cylinder after the brake pedal is released can be caused by air trapped in the system or open replenishing ports in the master cylinder.

60. When constant pressure on the brake pedal results in the brake pedal moving to the floor, the problem is an internal leak in the master cylinder. This is answer A. The other answers would affect brake operation with a normal pedal feel. **The correct answer is A.**

61. Answer A is correct. Insufficient pedal play can cause fluid pressure buildup. Answer B is wrong. A master cylinder piston seal leak would not cause a rising brake pedal. Choice C is also wrong. Reversed brake shoes would not cause a rising brake pedal. Choice D is wrong; a sticking wheel cylinder piston would not cause a rising brake pedal. **The correct answer is A.**

62. When brake fluid drips inside the vehicle, the fluid must be leaking from the rear of the master cylinder, as only this part is exposed to the interior of the vehicle. The pushrod boot is not designed to keep fluid in; it is designed to keep dirt out of the master cylinder. Both an overfilled master cylinder and leaking take up valve would show signs under the hood. **The correct answer is A.**

63. To answer this question, think of the location of the parts in a master cylinder. The secondary cup leakage would leak fluid on or near the firewall because it is located internally there in the master cylinder. Technician B is wrong. The primary cup on the secondary piston would only cause an internal leak. **The correct answer is A.**

64. This is an except-type question that has all true statements but one. That one false statement is answer D. When a master cylinder is being removed from a vehicle that has power brake assist, the brake pedal push rod does not need to be removed. This is also true for many non-power assisted systems. **The correct answer is D.**

65. Both technicians are right. During bench bleeding of a master cylinder, the reservoirs should be kept nearly full while a blunt object is moving the master cylinder's pistons in and out. This action will cause the air in the cylinder to be replaced by clean fluid. **The correct answer is C.**

66. If new pads with rebuilt calipers tend to make the vehicle's brake pedal hard or require extra effort to stop, the cause could be that the pads have been heated to the point of glazing; it will take excessive brake pedal effort. Answer choice B will cause a spongy pedal. Choice C will cause brake dragging, and choice D will cause a pull or a hard brake pedal. **The correct answer is A.**

67. Many things can cause brake pull accompanied by a vibration; however, of the answers, only one will cause this problem: answer C. Contaminated brake shoes can cause uneven brake friction at the wheels. A broken parking brake cable will not affect normal brake operation. Weakened front brake hoses will cause a spongy pedal feel. And, a malfunctioning proportioning valve will not cause a pull or vibration; it will cause poor braking. **The correct answer is C.**

68. Both technicians are right. Whenever a brake hose connection is broken loose, replace the sealing washer. **The correct answer is C.**

69. Whenever you need to replace a brake line, make sure the line is made of double walled steel tubing and it is the same shape and length as the original. **The correct answer is B.** Never install a piece of hose in place of a brake line. Also never use copper tubing or corrugated steel tubing because they cannot withstand hydraulic brake pressure.

70. The sole purpose of a metering valve is to meter the pressure going to the rear and front brakes. This is done to limit the amount of nosedive, which adversely affects brake effectiveness. A bad master cylinder, proportioning valve, or vacuum check valve would not cause this problem. **The correct answer is B.**

71. The proportioning valve is designed to prevent rear wheel lockup as the brakes are heavily applied. A bad differential valve or height sensing valve would not cause this problem. Nor would a bad metering valve as it merely regulates front brake pressure. **The correct answer is A.**

72. Neither technician is correct. Bleeding should be done with the vehicle at curb height and full weight on the axles. **The correct answer is D.**

73. To test the brake warning light circuit, ground the wire to the switch with the ignition on. Grounding the switch with the ignition off will do nothing, as the circuit is not powered when the ignition is off. Applying voltage to the switch or wire harness plug will cause a short to ground and may melt the jumper wire and your fingers. **The correct answer is B.**

74. The tool shown is used to keep the metering valve open during bleeding. **The correct answer is B.**

75. Vacuum bleeding pulls fluid and hopefully air from the system. The key to bleeding this way is to make sure the master cylinder remains full. Technician A is right. Technician B is wrong; vacuum bleeding does not add or push fluid into the system. **The correct answer is A.**

76. Answer A is wrong. The rear wheel cylinders should not be bled first. Answer choice B is also wrong. The left front caliper should not be bled first when air in the master cylinder is suspected. Answer C is also wrong; the height sensing proportioning valve should not be bled first. Only answer D is right; when air is suspected to be trapped in the master cylinder, the master cylinder should be bled first. **The correct answer is D.**

77. Both technicians are right and **the correct answer is C.** Surge bleeding can be used in addition to both manual and pressure bleeding.

78. The component being tested in the figure is a proportioning valve. **The correct answer is C.**

79. All of the answers for this question can cause drum brake chatter. The least likely cause would be answer D. A torn wheel cylinder boot could only cause chatter but only in a very remote way. Therefore choice D is the least likely cause and **the correct answer is D.**

80. When turning a drum, make sure you leave at least 0.030 inches under the discard size to allow for some future wear. **The correct answer is A.**

81. Neither technician is right. Linings should be replaced when contaminated. Also, a torch should never be used on linings. **The correct answer is D.**

82. The bores of a wheel cylinder should only be cleaned with denatured or isopropyl alcohol. Other cleaning agents may leave a film behind, which can contaminate the fluid. **The correct answer is D.**

83. Only Technician A is right. The ledges on the backing plate should be lubricated as the shoes rub against them. Technician B is wrong. If the arc of the shoes doesn't match the bosses on the backing plate, either the shoes are arced wrong or the backing plate is the wrong one. **The correct answer is A.**

84. Of the answers only choice A could cause a high pedal. The others would cause problems such as a spongy pedal or vibrations, but not a high pedal. **The correct answer is A.**

85. A pull to one side indicates a problem on one side of the vehicle. Only choice A provides for that solution. A faulty brake caliper on one side of the vehicle will cause it to pull. **The correct answer is A.**

86. Only Technician A is correct here. Brake pedal pulsation could be caused by loose front wheel bearings and not by worn outer CV-joints. Worn joints cause noise and/or vibrations during cornering. **The correct answer is A.**

87. The answer is obvious if you have ever done this task. The figure shows the use of a seal driver. The part the seal is being driven into is a caliper. The only caliper seal that is driven in place is the dust boot, which is answer choice C. **The correct answer is C.**

88. Technician A is wrong; a problem in the caliper on the left side would cause the vehicle to pull to the right. Technician B is right; a problem on the right side would cause a pull to the left. **The correct answer is B.**

89. The best and only truly acceptable way to remove minor scratches from a caliper bore is crocus cloth because it removes very little metal and will have little effect on the sealing of the piston. The other answers would prevent proper piston sealing. **The correct answer is B.**

90. Based on a technicality, Technician A is wrong. Caliper retaining hardware is not part of a normal caliper rebuilding service. Technician B is correct. The seal is usually the first to wear and should always be replaced. **The correct answer is B.**

91. The only way to measure a brake rotor for parallelism is with a micrometer. To do this, measure the thickness of the rotor at eight different locations, about 45 degrees apart. Any difference in measurement lets you know the rotor is not parallel. **The correct answer is B.**

92. Technician A is right; a brake rotor should be refinished if it fails a lateral runout check. Technician B is also right; a rotor should be refinished if it fails a thickness variation check. **The correct answer is C.**

93. Again, both technicians are correct and **the correct answer is C.** To make the rotor nondirectional after resurfacing it, the rotor should be sanded. A finer grit is always used when a machine does the sanding.

94. Only Technician A is right. On most vehicles, the parking brake must be fully released before adjustment. Technician B is wrong; partial engagement of the parking brake is required on some drum-type parking brakes. **The correct answer is A.**

95. A common cause of pedal pulsation is a distorted rotor and the primary cause of this distortion is what is suggested by answer A, over-tightening of lug nuts. The other answer choices would not cause pedal pulsation. **The correct answer is A.**

96. Reduced boost from a Hydro-Boost system is most likely caused by a defective accumulator. The accumulator holds reserve fluid, that in the event of loss of fluid in the system would assist in applying the brakes. Glazed brake pads would not reduce power assist. Nor would a sticking parking brake or incorrectly adjusted rear brakes. **The correct answer is A.**

97. Excessive end play would cause brake pedal pulsations. One of the causes of excessive end play is loose or damaged wheel bearings. **The correct answer is D.**

98. All of the answers could cause the red brake warning light to illuminate except D; **the correct answer is D.** A shorted brake warning switch would complete the electrical path for the lamp and keep it on continuously. A worn master cylinder and a leak in the system could cause a pressure differential in the system and cause the lamp to light. **The correct answer is D.**

99. In most vehicles, the stop lamps are wired with the turn signal circuit. Therefore answer C could be the cause of the problem. A bad ground or wire would make the brake lamp circuit open and the lamps could not illuminate. Although the stop lamps are wired with the turn signals, the flasher unit for the turn signals has nothing to do with the stop lamps. Therefore a bad flasher unit is a very unlikely cause for inoperative stop lamps. **The correct answer is B.**

100. Both technicians are right. It is normal, on some vehicles, for the brake pedal to pulsate when the ABS is working. Brake pedal pulsations can also be caused by excessive rotor runout. **The correct answer is C.**

Glossary

Acetone A highly flammable liquid sometimes used to clean parts.

Air gap A small space between two parts.

Air shock A shock operating on the principles of air pressure; may also have a hydraulic section.

Battery A device for storing electrical energy in chemical form.

Bench bleeding A procedure for bleeding air from a master cylinder before installing it in a vehicle.

Bleeder screw A small valve-like screw located on each wheel cylinder and master cylinder used to bleed air from the brake system.

Bleeding The act of removing air from a hydraulic brake system.

Boiling point The temperature at which a substance, such as a liquid, begins to boil.

Boot A flexible rubber or plastic cover over the end of wheel cylinders or master cylinder to keep out water and other foreign matter.

Brake A system used to slow or stop a vehicle; to slow or stop a vehicle.

Brake light Red lamps at the rear of a vehicle to warn others that a braking action is taking place.

Brake light switch A switch found on the brake linkage or in the hydraulic system that activates the brake lights.

Brake line A small diameter rigid steel tube that connects the brake system to the brake hose which, in turn, connects to the wheel cylinders.

Brake pads A friction material applied to the disc by the caliper to slow or stop a vehicle.

Brake system The system in a vehicle that is used to slow or stop a vehicle.

Brake warning light An instrument panel lamp that warns of a brake system function or a malfunction.

Check valve A valve, usually spring loaded, that allows the passage of fluid or vapor in one direction but not the other.

Circuit A complete path for an electric current; a compete path for a fluid system.

Cruise control A system that allows a vehicle to maintain a preset speed though the driver's foot is not on the accelerator pedal.

Denatured alcohol Ethyl alcohol used to clean brake parts.

DOT an abbreviation for the Department of Transportation.

Drum That part of a brake that rotates with the wheel and the brake shoes press against to slow or stop the vehicle.

Electronic control unit A digital computer that controls engine and transmission functions.

Equalizer A device in the brake cable system that prevents one side from being applied before the other.

Glycol A term used for ethylene glycol, an antifreeze solution.

Grease Lubricant containing a mixture of oil, soap thickeners, and other ingredients.

Heat A form of energy.

Housekeeping A routine of cleaning and other practices to insure a safe and healthy workplace environment.

Hydraulic booster A type of brake power booster that uses hydraulic pressure from the power steering system pump.

Hydro-boost A power brake booster that utilizes hydraulic pressure from the power steering system pump.

Ignition switch A multi-position master switch, usually key operated, in a vehicle.

Lamp A device used to convert chemical energy into radiant energy, usually visible light.

Lateral runout A rotating member that has excessive variations in the amount of sideways wobble when turning.

Leaf spring A rear vehicle suspension system component consisting of one or more flat leaves of steel with graduated lengths.

Lining A friction material attached to a brake part used to slow or stop a vehicle.

Manifold A device used to hold two or more instruments for testing purposes; a device used to channel the air/fuel mixture into an engine; a device used to channel exhaust vapors out of the engine.

Mineral spirits A cleaning solvent.

Modulator A device that regulates hydraulic pressure.

Nitrogen A high pressure odorless, colorless, tasteless gas that is often used to pressurize a system for leak testing.

Normally closed A term that refers to a switch or valve in its normal position, closed.

Normally open A term that refers to a switch or valve in its normal position, open.

Open circuit A circuit in which there is a break in continuity.

Pad wear indicator A mechanical or electrical warning device on the disc brake pad that warns of the need for pad replacement.

Piston A round caliper component in a disc brake; an aluminum or sintered iron component of a drum brake inside a wheel cylinder; the valve-like rod in a master cylinder.

Power steering A steering system that used hydraulic pressure to increase the torque applied to the steering wheel.

Pressure bleeder A device used to facilitate the removal of air from a brake system.

Pushrod A rod that transmits the movement and force of the wheel cylinder piston to the brake shoe.

Relay An electro-mechanical switch.

Rotor A disc shaped brake component that rotates with the wheel.

Shoe The lining and its steel backing of a drum brake.

Short circuit The intentional or unintentional grounding of an electrical circuit.

Silicone A group of organic compounds based on the element silicon (Si).

Sliding caliper A disc brake caliper that has piston(s) on one side of the caliper only.

Solenoid An electro-mechanical device used to impart a push-pull motion.

Specifications Technical data usually supplied by the vehicle manufacturer.

Spindle A shaft or axle on which a wheel hub or bearing rides.

Stoplight switch An electrical switch on the brake linkage or in the hydraulic system used to illuminate the brake lights when the brake pedal is depressed.

Torque steer An outside influence of a front-wheel drive vehicle, such as uneven front tire-tread wear that causes the steering wheel to turn right or left during hard acceleration.

Vacuum booster A power brake activation system that uses a vacuum signal on one side of a diaphragm to amplify braking effort.

Vacuum gauge A device used to measure vacuum.

Vacuum hose A small diameter rubber, plastic, or nylon tube used to transmit a vacuum signal.

Vacuum motor A diaphragm or motor-like device actuated by a vacuum.

Vapor A gas.

Warning light A light, usually on the dash, to warn of a problem.

Wear limit The manufacturers' specifications as to the durability of a part in terms of serviceability.

Wiring harness The major assembly or a sub-assembly of a vehicle's wiring system.