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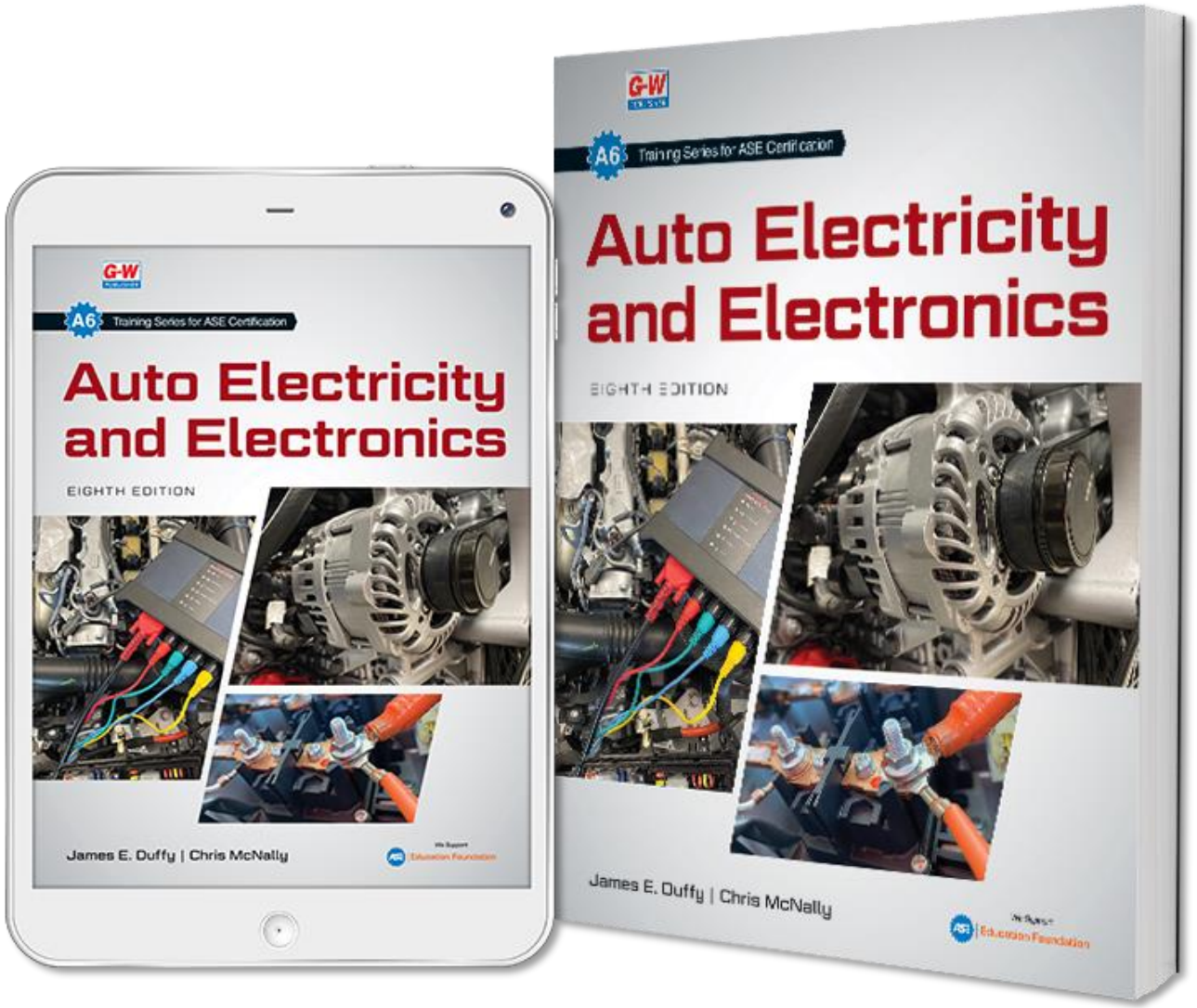

Auto Electricity and Electronics

Together, We Build the Future

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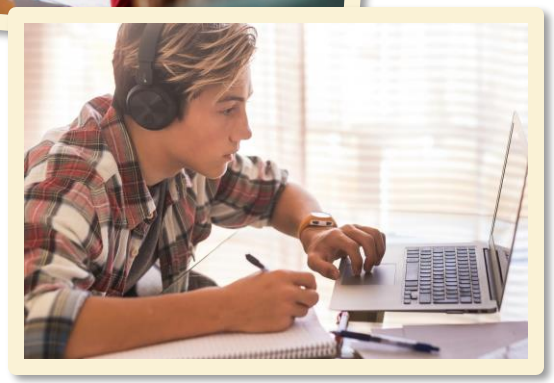

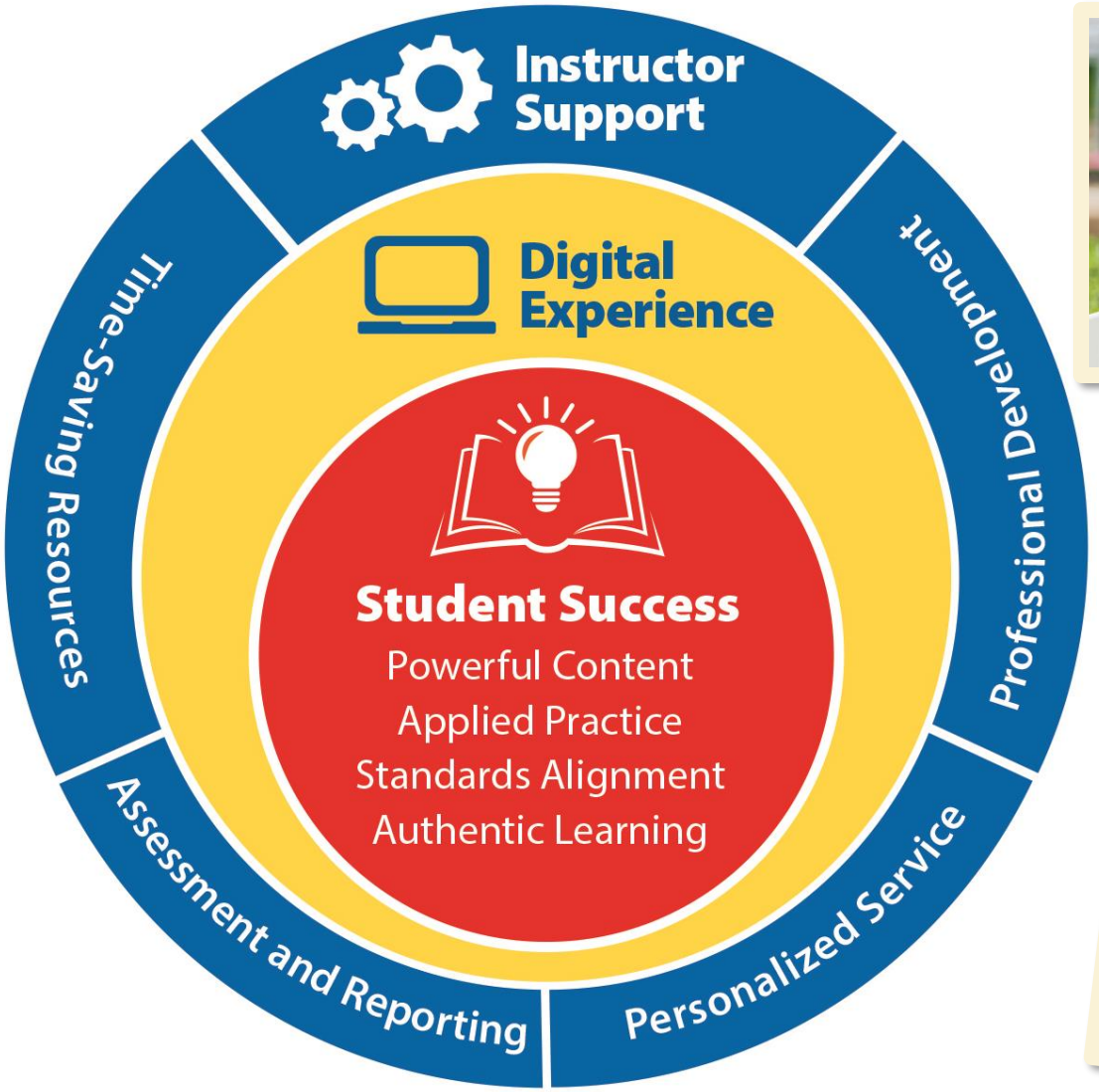

Student Success Is At the Heart of What We Do

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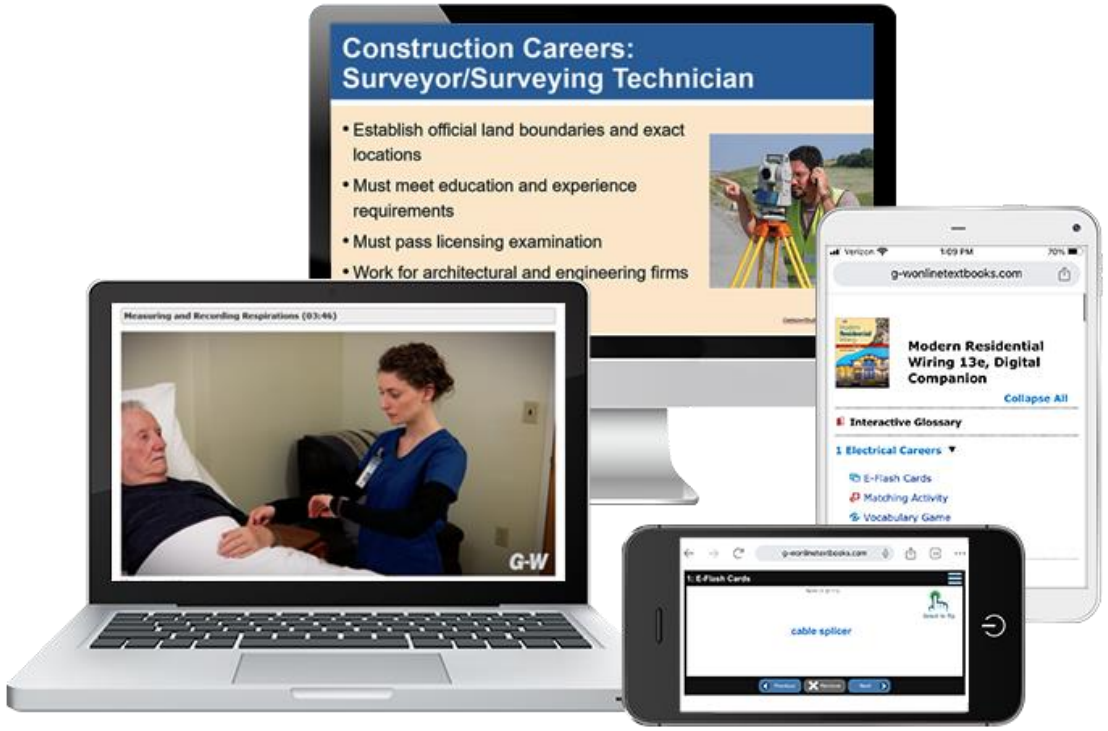


*Shown are examples across various titles

- ✓ Prepare for class
- ✓ Reinforce new concepts
- ✓ Assess learning

Ready-to-Implement Online Instructor Resources

Auto Electricity and Electronics: Lesson Plan

Instructor: *Date:*
Course: *Unit:*

Chapter 1: Basic Safety Principles

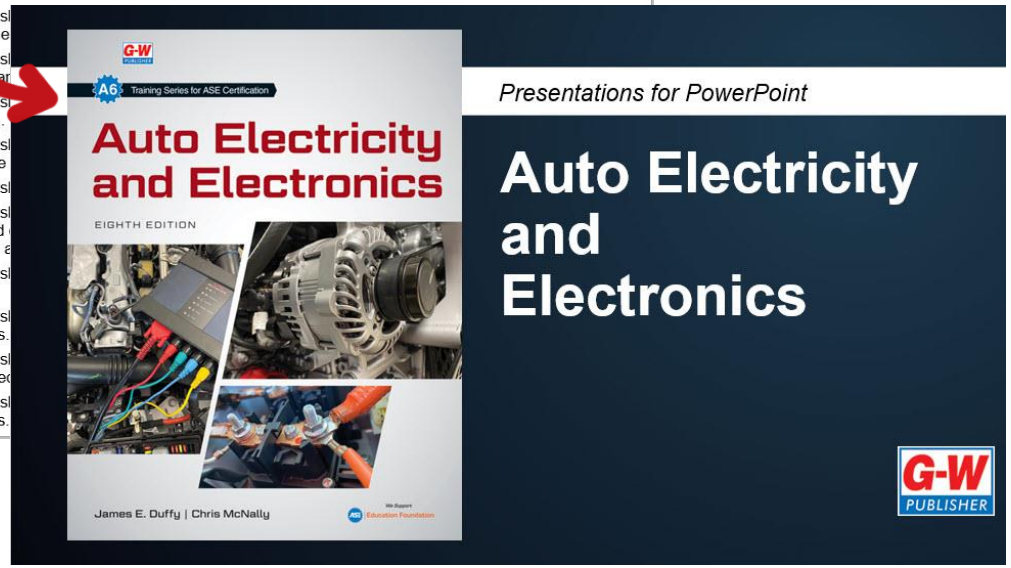
Learning Outcomes

- 1.1 Identify sources of electric shock encountered in the automotive shop.
- 1.2 Explain how to prevent electrical burns and electrical fires.
- 1.3 Recall the steps to take in case of an electrical fire.
- 1.4 Apply safety rules when working with automotive batteries.
- 1.5 Apply rules for working safely around gasoline.
- 1.6 Apply general safety rules when working in an automotive shop.
- 1.7 Summarize the hazards of working on hybrid vehicles.

ASE Education Foundation MLR Tasks

This chapter addresses the following ASE Education Foundation MLR Tasks:

- Supplemental Tasks—Shop and Personal Safety, Task 1: Identify general shop safety rules and procedures.
- Supplemental Tasl
  tools and equipme
- Supplementa Tasl
  jacks and jac
- Supplemental Tas
  safe lift operation.
- Supplemental Tasl
  working within the
- Supplemental Tasl
- Supplemental Tasl
  extinguishers and
  fire extinguishers a
- Supplemental Tasl
  stations.
- Supplemental Tasl
  evacuation routes.
- Supplemental Tasl
  glasses, ear protec
- Supplemental Tasl
  lab/shop activities.



Lesson Plans, PowerPoint Presentations, and Answer Keys

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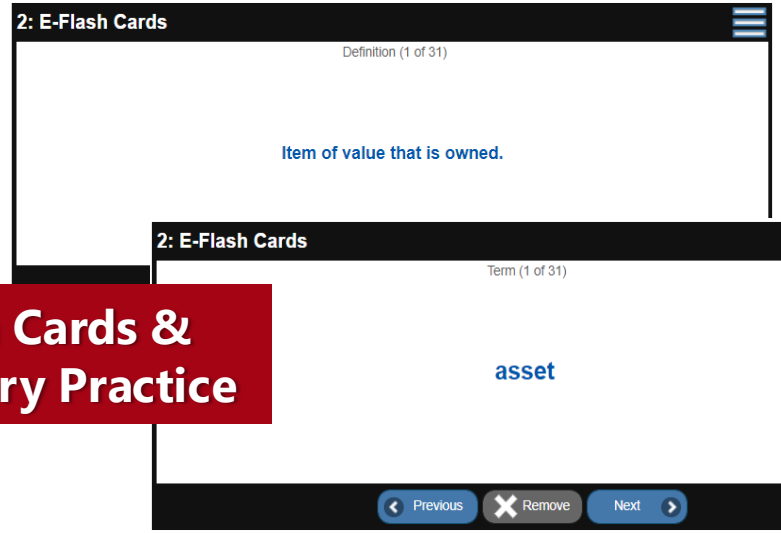
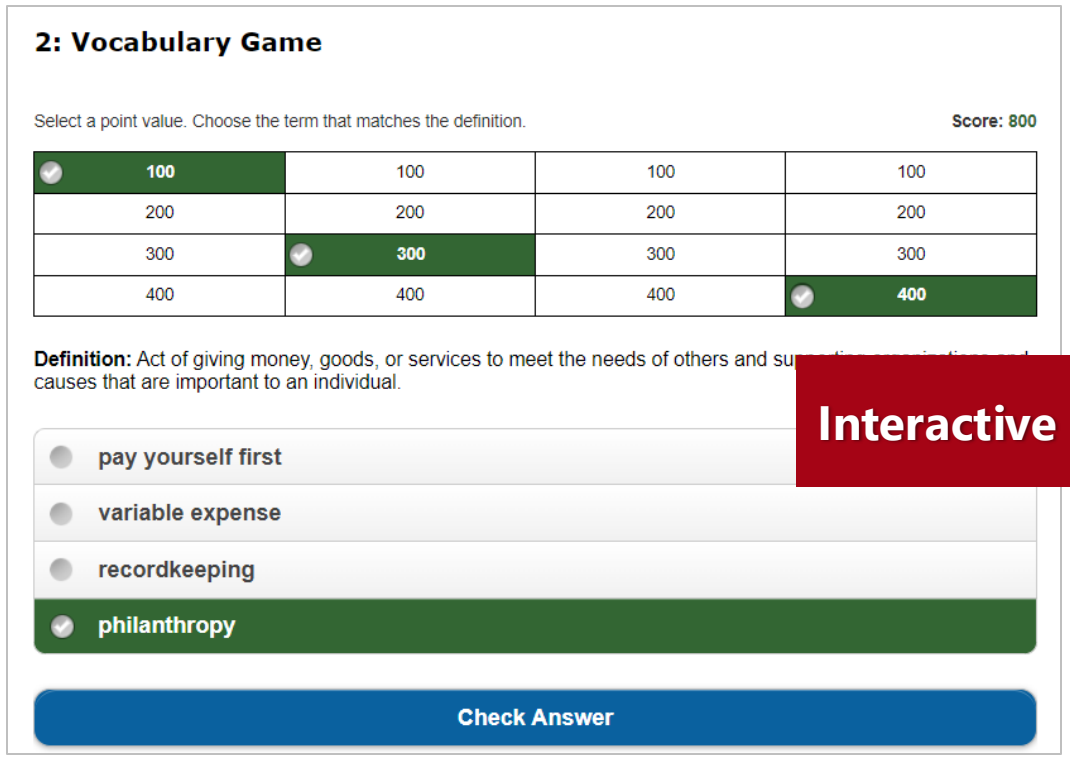
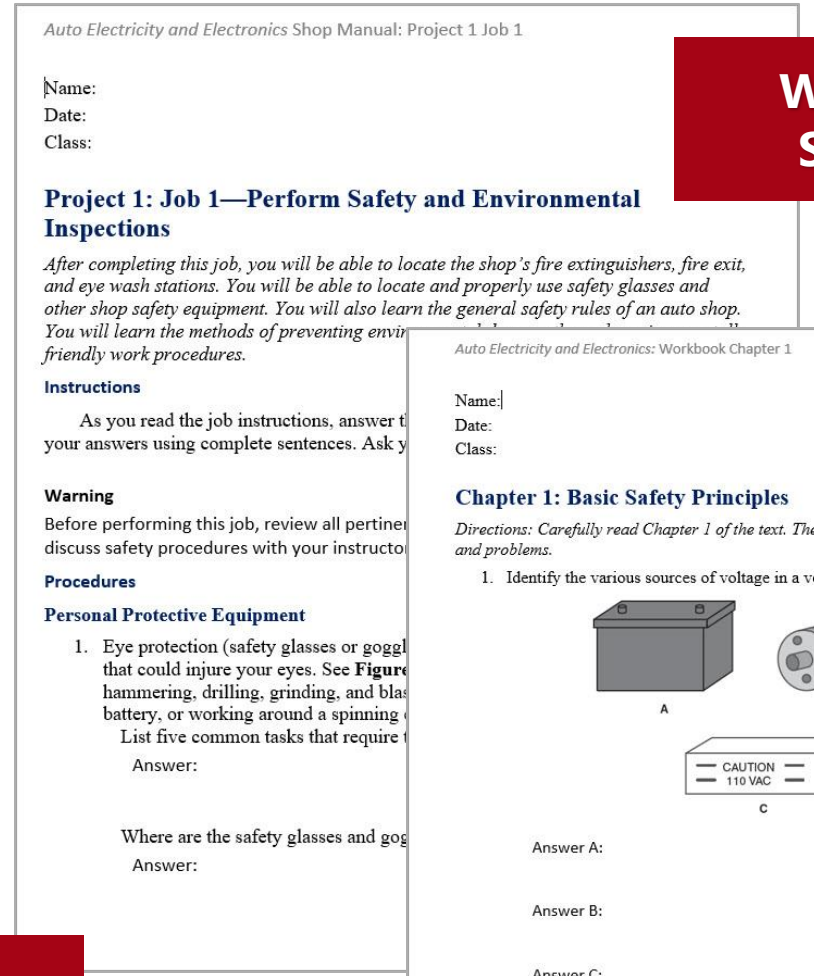


E-Flash Cards & Vocabulary Practice



Interactive Activities


Auto Electricity and Electronics Shop Manual: Project 1 Job 1

Name:
Date:
Class:

Project 1: Job 1—Perform Safety and Environmental Inspections

After completing this job, you will be able to locate the shop's fire extinguishers, fire exit, and eye wash stations. You will be able to locate and properly use safety glasses and other shop safety equipment. You will also learn the general safety rules of an auto shop. You will learn the methods of preventing envir... friendly work procedures.

Instructions

As you read the job instructions, answer t... your answers using complete sentences. Ask y...

Warning

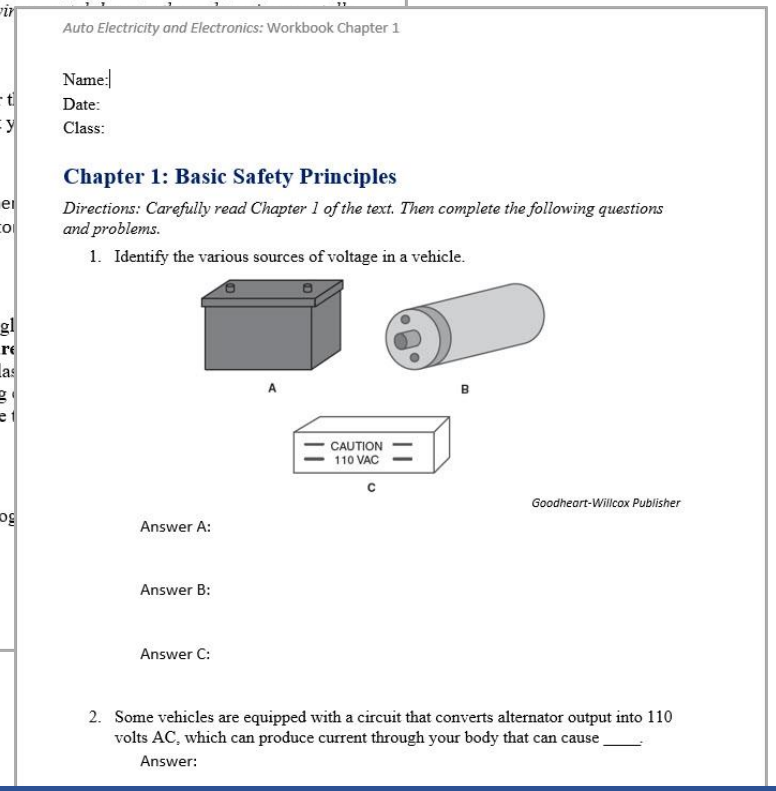
Before performing this job, review all pertine... discuss safety procedures with your instructo...

Procedures

Personal Protective Equipment

1. Eye protection (safety glasses or goggl... that could injure your eyes. See **Figure**... hammering, drilling, grinding, and bla... battery, or working around a spinning ...
   List five common tasks that require t...
   Answer:

   Where are the safety glasses and gog...
   Answer:


Auto Electricity and Electronics: Workbook Chapter 1

Name:
Date:
Class:

Chapter 1: Basic Safety Principles

Directions: Carefully read Chapter 1 of the text. Then complete the following questions and problems.

1. Identify the various sources of voltage in a vehicle.

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Answer A:

Answer B:

Answer C:

2. Some vehicles are equipped with a circuit that converts alternator output into 110 volts AC, which can produce current through your body that can cause ____.
   Answer:

Workbook and Shop Manual

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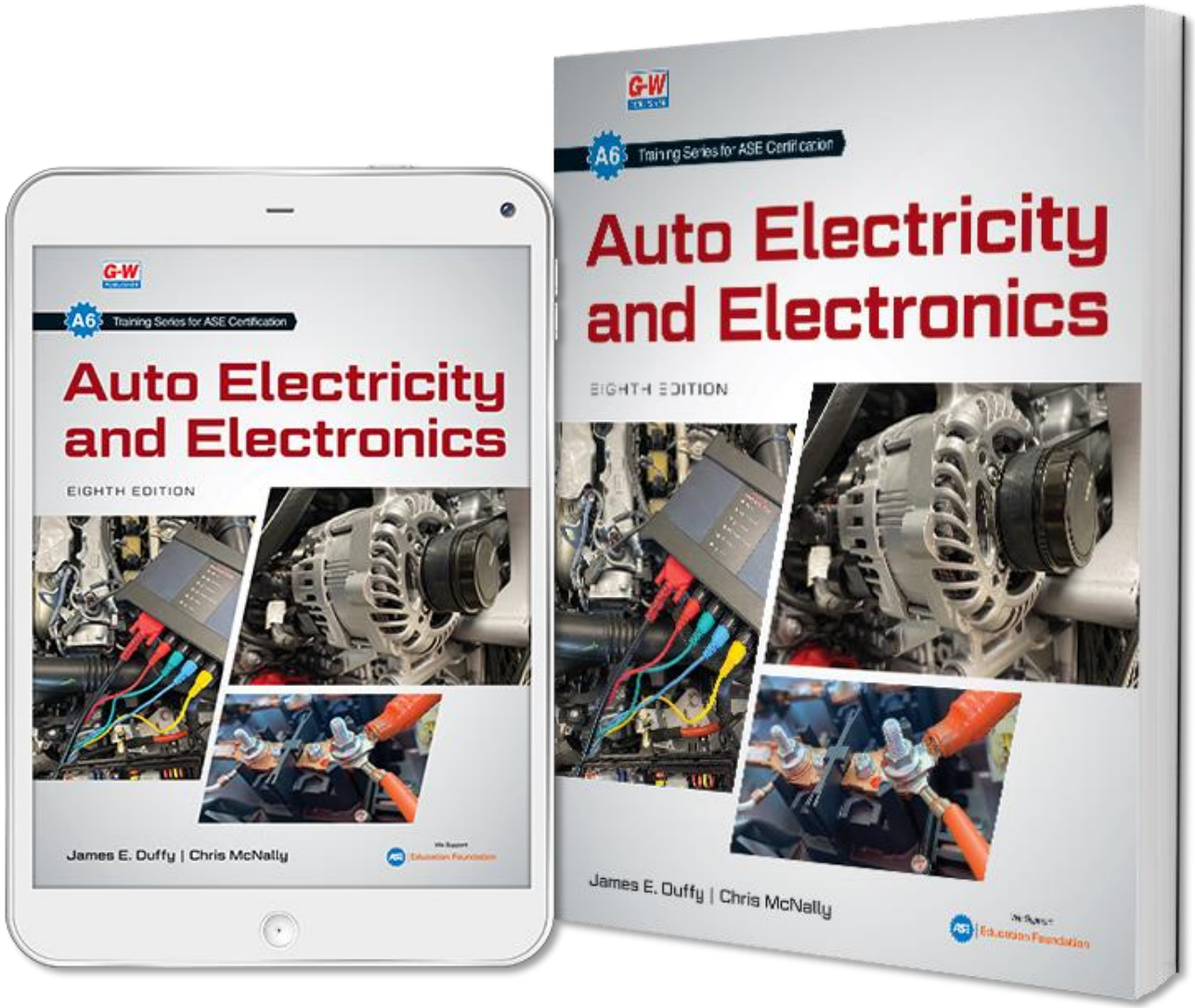

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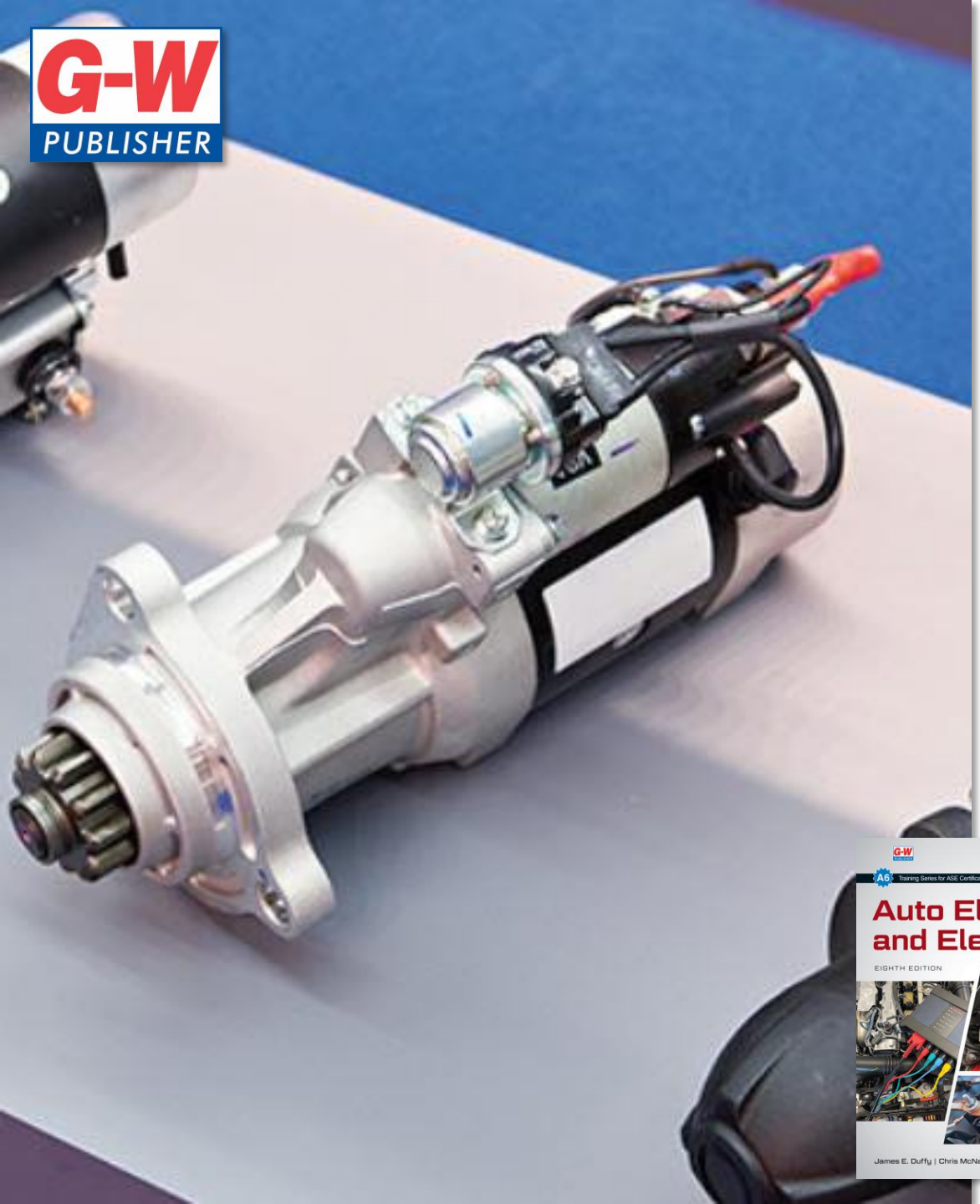
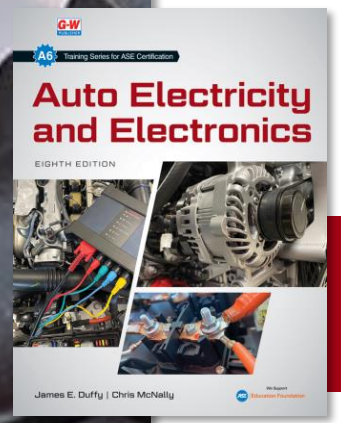
by James E. Duffy and Chris McNally





Brief Contents

Student Textbook

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SHOP TALK

Being an automotive/light truck technician is a rewarding and often fun job, but it comes with certain risks. As technicians, we must take the risk of getting injured seriously. Many technicians will experience minor injuries, such as cuts and bruises or minor burns. Because automotive shops contain hazards, some technicians are seriously injured on the job every year. Most of these injuries can be avoided by following simple, commonsense rules. It is up to you to follow general safety rules and those set by your employer.

Apply and Analyze

1. What are the common indicators that there may be battery pack problems? What problems do these symptoms indicate? (32.2)
2. Describe the function of a battery's state of health (SOH). (32.2)
3. Why are milliohm meters important for diagnosing issues in electrical motors? (32.3)

Critical Thinking

1. Create a poster outlining proper safety procedures for BEV service. (32.1)
2. When rebuilding a battery module or pack, it is necessary to replace faulty cells with replacement cells that have comparable internal resistance readings to the remaining original cells. Explain why this is necessary. (32.2)
3. Describe in detail the process of balancing a battery pack with an external battery balancer/load leveler. (32.2)

ASE-Type Questions

1. Technician A says EH-rated shoes should be worn when working on a BEV. Technician B says leather gloves will protect you from the high voltage in a BEV. Who is correct? (32.1)
   A. A only.
   B. B only.
   C. Both A and B.
   D. Neither A nor B.
2. Technician A says only the meter leads need to be rated for use on BEVs. Technician B says the me

CHAPTER 31

Battery Electric Vehicles

What's New to the Edition

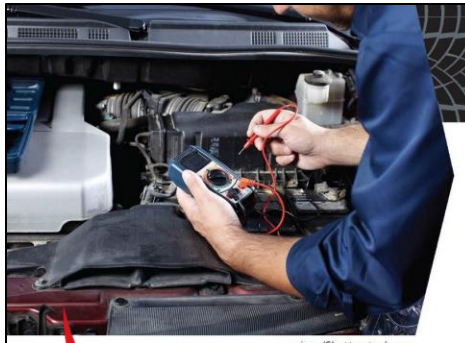
Critical Thinking

1. Access the wiring diagram for the left low-beam headlight circuit for the vehicle of your choice. Examine the wiring diagram and identify all components, connectors, and splices that could cause an inoperative left low-beam headlight. (9.1)
2. Research and explain why high resistance in a switch could cause poor performance from a circuit load. (9.2)

ASE-Type Questions

1. Technician A says a basic circuit problem can be caused by something in the circuit that increases voltage. Technician B says a basic circuit problem can be caused by something in the circuit that decreases resistance. Who is correct? (9.2)
   A. A only.
   B. B only.
   C. Both A and B.
   D. Neither A nor B.
2. An automobile is brought into the shop with an engine electrical problem. Technician A says the first step to electrical diagnosis is to verify the symptoms and the problem. Technician B says electrical diagnosis involves using a logical sequence of steps to find the source of the problem. Who is correct? (9.2)
   A. A only.
   B. B only.
   C. Both A and B.
   D. Neither A nor B.
3. More than one component in a particular automotive electric circuit is not working. Technician A refers to the diagnostic flowchart in the service information. Technician B immediately begins testing the circuit at its load. Who is correct? (9.1)
   A. A only.
   B. B only.
   C. Both A and B.
   D. Neither A nor B.
4. There is an open in an automobile's headlight circuit. Technician A says this problem can be caused by a blown fuse. Technician B says the problem may be caused by broken filament in a bulb. Who is correct? (9.2)
   A. A only.
   B. B only.
   C. Both A and B.
   D. Neither A nor B.
5. Technician A says an open will stop current in a circuit. Technician B says high circuit resistance will increase current in a circuit. Who is correct? (9.2)
   A. A only.
   B. B only.
   C. Both A and B.
   D. Neither A nor B.
6. Technician A says a short circuit can be caused by a conductor touching ground. Technician B says a short circuit can be caused by a conductor touching another conductor. Who is correct? (9.2)
   A. A only.
   B. B only.
   C. Both A and B.
   D. Neither A nor B.
7. Technician A says intermittent problems occur only under certain conditions. Technician B says intermittent problems can be caused by poor electrical connections. Who is correct? (9.2)
   A. A only.
   B. B only.
   C. Both A and B.
   D. Neither A nor B.
8. A vehicle keeps blowing its fuse to the lighting system. Technician A says that a larger amp fuse might correct the trouble quickly and easily. Technician B says that installing a larger fuse could cause a serious electrical fire. Who is correct? (9.1)
   A. A only.
   B. B only.
   C. Both A and B.
   D. Neither A nor B.
9. The current in an automotive taillight circuit needs to be checked. Technician A connects a conventional ammeter in parallel with the circuit being tested. Technician B connects a conventional voltmeter in series with the circuit being tested. Who is correct? (9.3)
   A. A only.
   B. B only.
   C. Both A and B.
   D. Neither A nor B.
10. A diode has a reading of infinite ohms in both directions. Technician A says this indicates the diode is in good condition. Technician B says this indicates that the diode has an internal short. Who is correct? (9.4)
    A. A only.
    B. B only.
    C. Both A and B.
    D. Neither A nor B.

ASE Education Foundation Task Lists



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CHAPTER 9

Basic Electrical Tests

LEARNING OUTCOMES

After studying this chapter, you will be able to:

9.1 Apply a systematic approach to diagnose and correct electrical problems.

9.2 Describe the four basic types of circuit problems.

9.3 Explain the proper use of testing devices to check component operation.

9.4 Summarize basic electric and electronic component tests.

TECHNICAL TERMS

ammeter
electrical diagnosis
grounded circuit fault
hot wire short to ground
infinite resistance
intermittent problem
jumper wire
ohmmeter
open circuit
short circuit to power
transducer switch
voltage drop test
voltmeter
zero resistance

SHOP TALK

Do you want to feel like a genius? Fix an electrical problem that has been to a couple of shops. Some electrical faults are quite complex, but most of them are pretty simple to resolve once they've been diagnosed. Understanding how electricity works, knowing how to read wiring diagrams, and using your test equipment properly are the fundamentals that will enable you to correctly and efficiently diagnose any electrical fault. Being proficient in these areas takes practice. The more time you spend working with electricity and your meters, the better you will get.

Chapter-Opening Materials

Tech Tip

When you are looking for shorts or opens, wiggle or move the wires while you are testing. This might move the conductor enough to produce the short. It might also correct the problem temporarily so that you can detect the trouble. Always look for wire damage. Check for cut or smashed wire insulation or loose connections. Any of these could cause a malfunction.

Warning

Test light probes are very sharp. It is easy to jab the probe through your skin when trying to penetrate the wire insulation. Do not place your fingers behind the probe when testing.

Caution

Never bypass a sensor switch unless you are sure the switch is designed to have almost zero resistance when closed. If a normally operating sensor is designed to have some resistance, even when closed, you could short the circuit and cause circuit damage when testing.

Special Features

Testing Capacitors

Capacitors are commonly used to absorb fluctuating voltage or current in a vehicle's electrical system. They can be used to prevent interference in the radio caused by unsmooth dc current or switches opening and closing. Capacitors were also used in older contact point ignition systems to prevent contact point burning.

Warning

A capacitor can store an electric charge. You should always ground the lead on a capacitor before testing it. A typical capacitor will not kill you, but it can startle you enough to make you jump or injure you. You also do not want a capacitor to discharge into and damage your ohmmeter.

To test a capacitor, you can use either an ohmmeter or a capacitor tester. To use a capacitor tester, follow the manufacturer's directions. To use an ohmmeter, disconnect and ground the capacitor's lead. Connect the ohmmeter leads across the capacitor as shown in Figure 9-41. At first, the ohmmeter should show low resistance as the capacitor takes a charge from the ohmmeter batteries. As the capacitor approaches its full charge, the ohmmeter reading should increase to infinite resistance. This shows that it is blocking dc current but storing voltage.

Testing Diodes

An ohmmeter is normally used to check diodes. A bad diode may have an internal open (PN junction burned and separated), or it may be shorted (PN junction burned and fused). The diode should have infinite resistance in one direction and low resistance in the other, as shown in Figure 9-42. If it does not, the diode should be replaced.

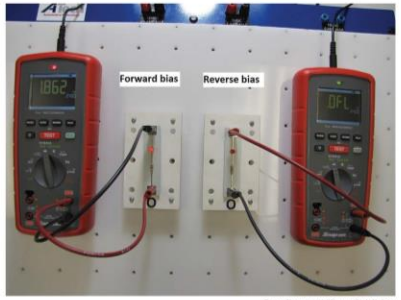

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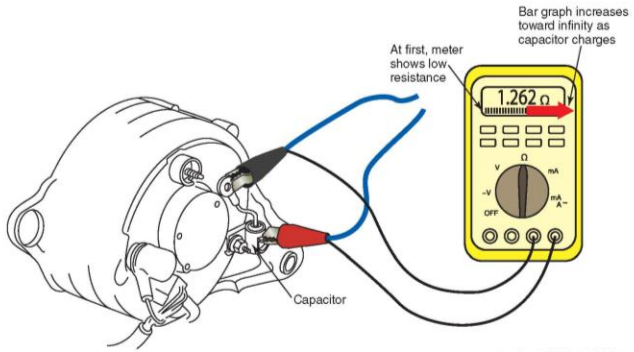
Figure 9-42. A diode will allow current in one direction (forward bias) and block current in the opposite direction (reverse bias).

Testing Transistors

A bad transistor will no longer amplify its base signal because one of the internal junctions has been damaged. Special transistor testers are available, but an ohmmeter can also be used to test transistors.

Tech Tip

Most transistors in complex circuits require the expertise of a specialized circuit technician. However, there are a few types of power transistors that frequently fail and can be checked and replaced in the field.



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Chapter 9 Review and Assessment

SUMMARY

- Electrical diagnosis involves using a logical sequence of steps to find the source of an electrical problem. The systematic approach to troubleshooting involves using the theory of system operation and logical thought processes to find the source of the problem quickly. (9.1)
- The four basic types of circuit problems are open circuit, high resistance, short to ground, and short to power. Any of these faults can be consistent or intermittent. (9.2)
- Technicians need to know how to use electrical testing equipment, including back probes, jumper wires, test lights, inductive wire tracers, multimeters, and oscilloscopes. (9.3)
- Basic electric and electronic component tests include testing connectors, resistors, switches, fuses, variable resistors, transducer switches, capacitors, diodes, and transistors. (9.4)

REVIEW QUESTIONS

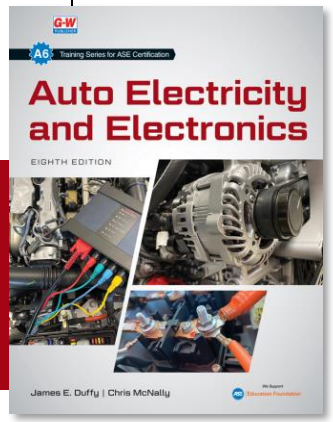
Answer the following questions using the information provided in this chapter.

Know and Understand

1. If the left low-beam headlight does not work, but all other lights in the circuit operate properly, what is the most likely fault? (9.1)
   A. The left low-beam bulb.
   B. The headlight circuit fuse.
   C. The left headlight shared ground.
   D. The left high-beam bulb.
2. What effect does an open circuit have on current? (9.2)
   A. No current.
   B. No voltage drop.
   C. Inoperative load.
   D. All of these.
3. What condition may cause an open circuit? (9.2)
   A. Blown fuse.
   B. Broken wire.
   C. Blown lightbulb.
   D. All of these.
4. What might make a bulb glow too dimly or a motor run slowly? (9.2)
   A. Excessive voltage.
   B. Excessive current.
   C. Excessive resistance.
   D. All of these.
5. An electrical short might cause: (9.2)
   A. an open fuse.
   B. an inoperative load.
   C. a fire.
   D. All of these.
6. Which testing device usually provides the quickest and easiest way to check for continuity in an unpowered circuit? (9.3)
   A. Voltmeter.
   B. Ammeter.
   C. Ohmmeter.
   D. Test light.
7. When can an oscilloscope be a more useful diagnostic tool than a multimeter? (9.3)
   A. When precise data is required.
   B. When testing battery voltage.
   C. When measuring resistance in a dead circuit.
   D. When a quick, general voltage reading is necessary.
8. An ammeter should be connected: (9.3)
   A. in parallel to a live circuit.
   B. in parallel to a dead circuit.
   C. in series in a live circuit.
   D. in a series in a dead circuit.
9. An ohmmeter shows a reading of 2.500 kΩ. What is the meter reading in ohms? (9.3)
   A. 2.5 Ω.
   B. 25 Ω.
   C. 250 Ω.
   D. 2500 Ω.
10. Which type of tester should be used to check for voltage in a computer circuit? (9.4)
    A. Low impedance test light.
    B. Analog multimeter.
    C. Digital multimeter.
    D. Any of these may be safely used.

Apply and Analyze

1. If more than one component does not work, where should you start your tests? (9.1)
2. List six conditions that may lead to an open circuit. (9.2)
3. What is an intermittent problem? Why do intermittent problems occur? (9.1)
4. Explain how to connect a conventional ammeter and an inductive ammeter to test a circuit. (9.3)
5. Explain how to use a test light to check a connector. (9.4)



End-of-Chapter Content

Auto Electricity and Electronics Shop Manual: Project 1 Job 1

Name:
Date:
Class:

Project 1: Job 1—Perform Safety and Environmental Inspections

After completing this job, you will be able to locate the shop's
and eye wash stations. You will be able to locate and properly
other shop safety equipment. You will also learn the general s
You will learn the methods of preventing environmental dama
friendly work procedures.

Instructions

As you read the job instructions, answer the questions and
your answers using complete sentences. Ask your instructor fo

Warning

Before performing this job, review all pertinent safety inform
discuss safety procedures with your instructor.

Procedures

Personal Protective Equipment

1. Eye protection (safety glasses or goggles) should be w
that could injure your eyes. See **Figure 1-1**. This inclu
hammering, drilling, grinding, and blasting, using com
battery, or working around a spinning engine fan.
List five common tasks that require the use of safety
Answer:

Where are the safety glasses and goggles kept in you
Answer:

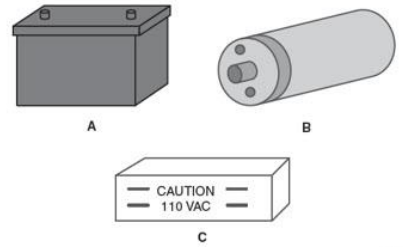
Auto Electricity and Electronics: Workbook Chapter 1

Name:
Date:
Class:

Chapter 1: Basic Safety Principles

Directions: Carefully read Chapter 1 of the text. Then complete the following questions and problems.

1. Identify the various sources of voltage in a vehicle.



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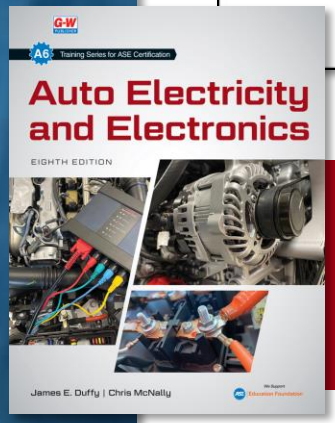
Answer A:

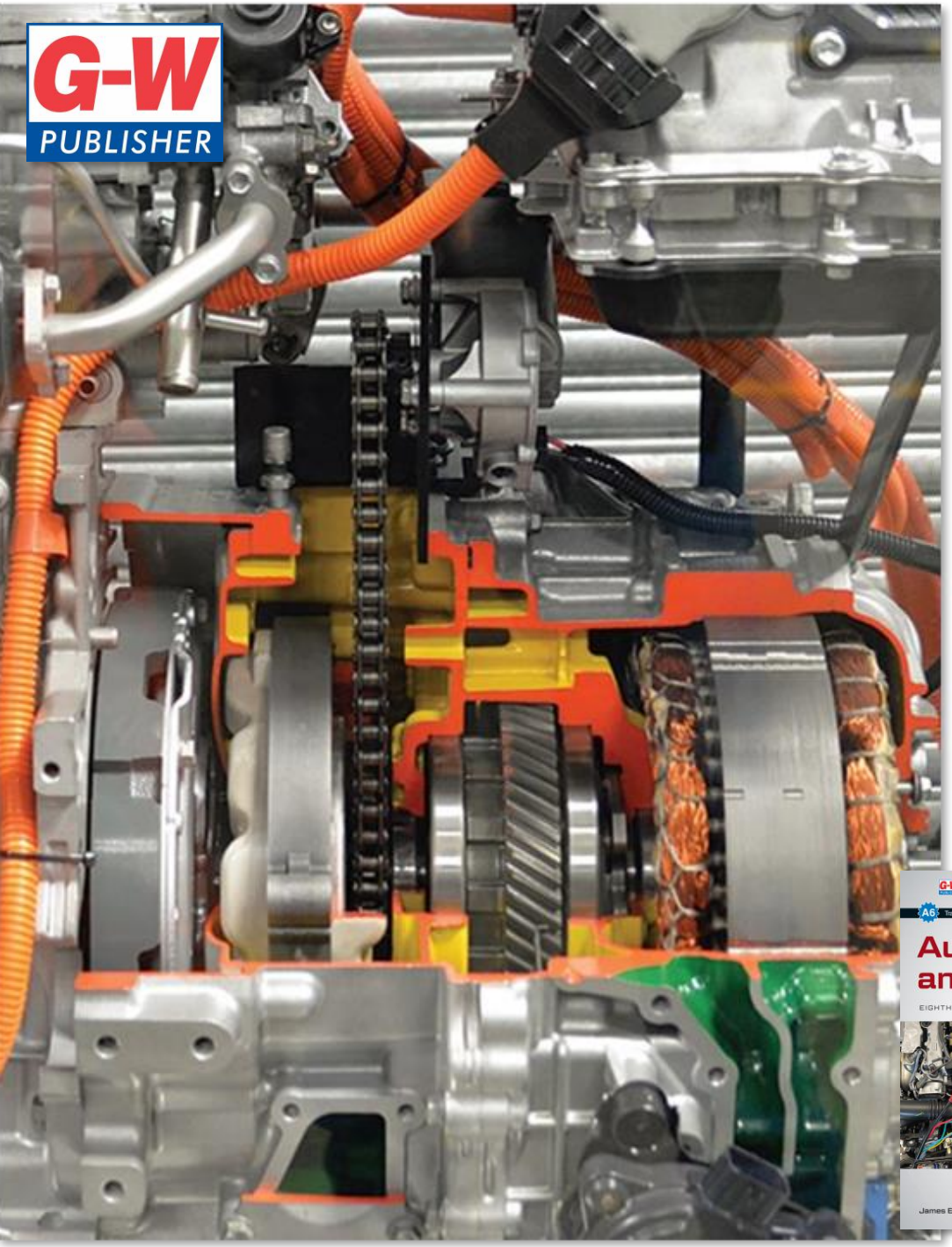
Answer B:

Answer C:

2. Some vehicles are equipped with a circuit that converts alternator output into 110 volts AC, which can produce current through your body that can cause _____.
Answer:



Workbook and Shop Manual



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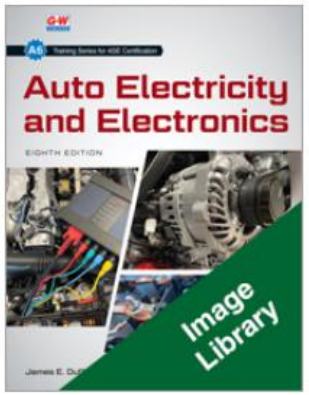

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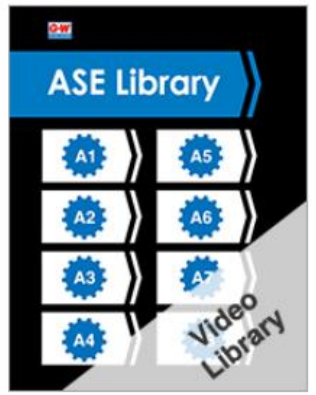
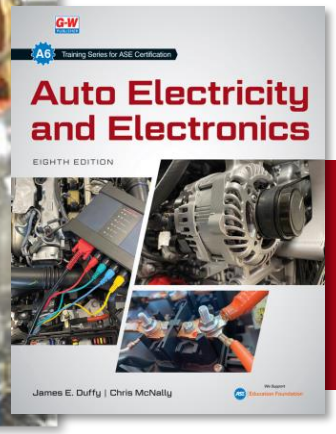


ASE Series Video Library

Automotive Virtual Toolbox

Multimeter Simulations



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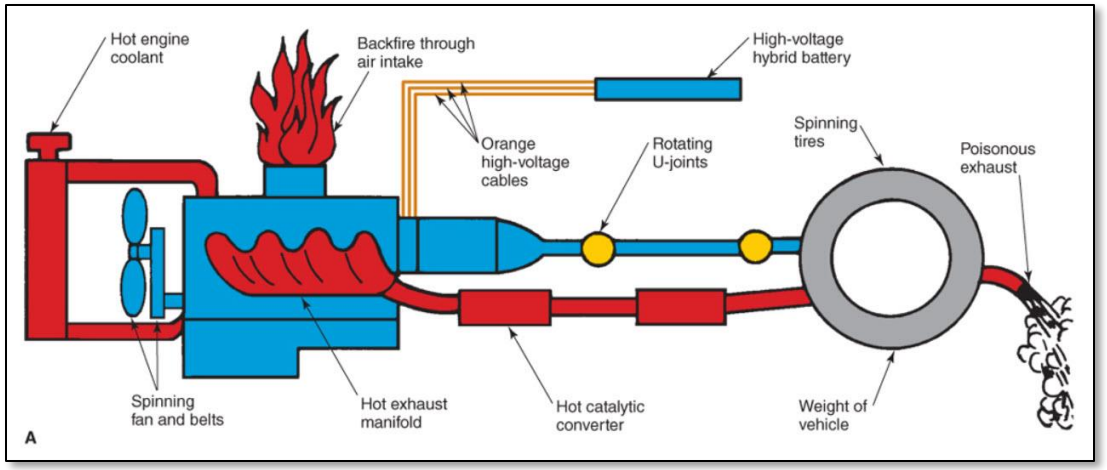

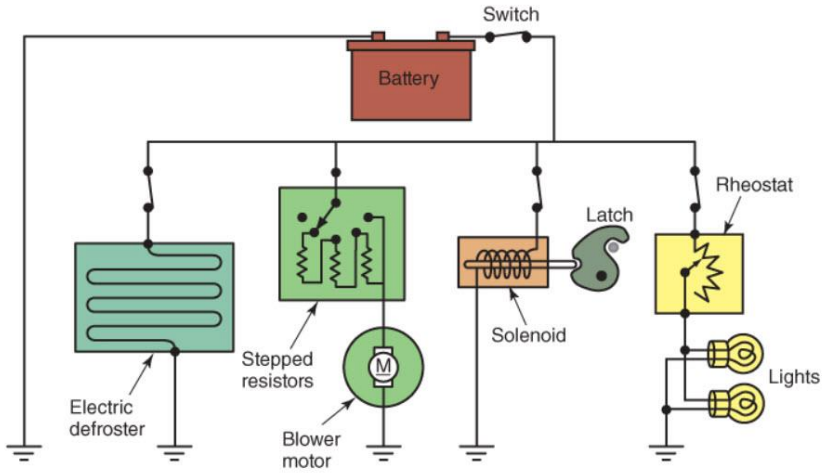

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Figure 5-1. Conventional electrical components are used to do many tasks in a vehicle's electrical system.
Description

Images and Illustrations

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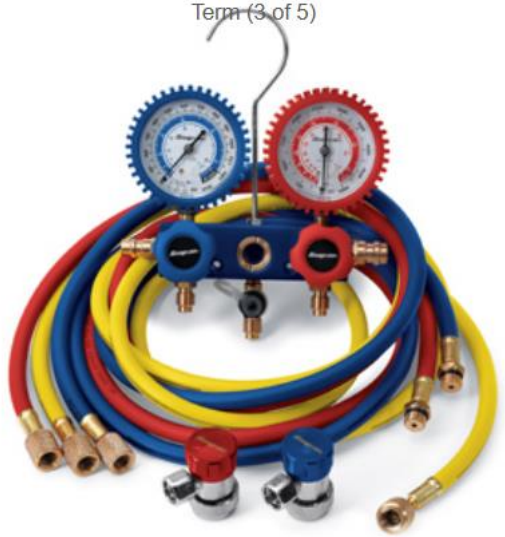
Auto Heating and Air Conditioning E-Flash Cards

Term (3 of 5)



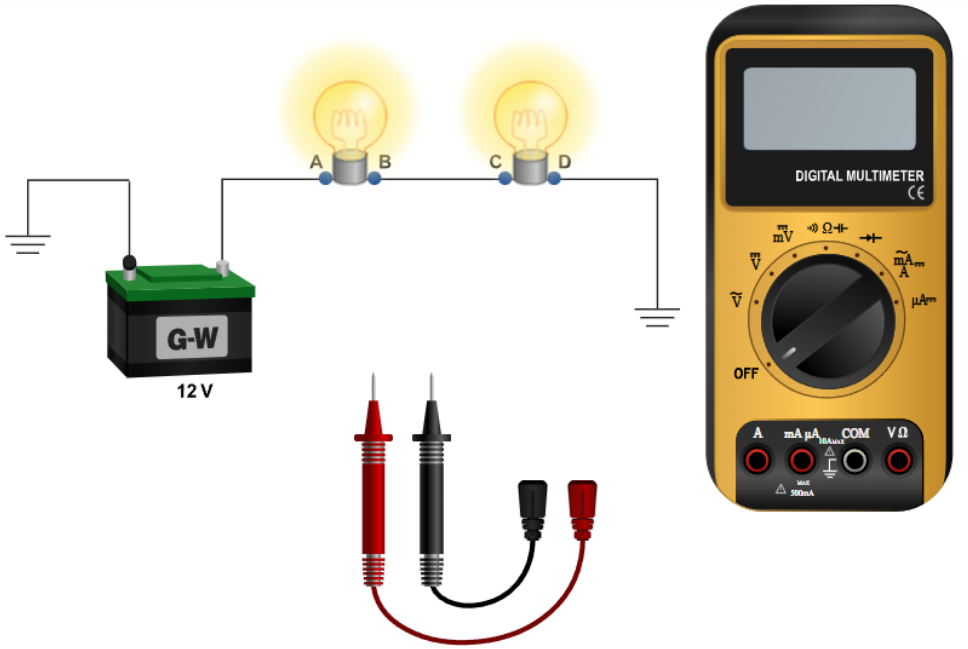
Previous | Remove | Next

Measuring Resistance in a Series Circuit: Problem 1

Battery
- Connected
- Disconnected

Multimeter Red Lead
- A
- mAμA
- VΩ
- Disconnected

Multimeter Black Lead
- COM
- Disconnected



Multimeter Setting: OFF

Multimeter Red Probe: Disconnected

Multimeter Black Probe: Disconnected

Virtual Toolbox and Simulations

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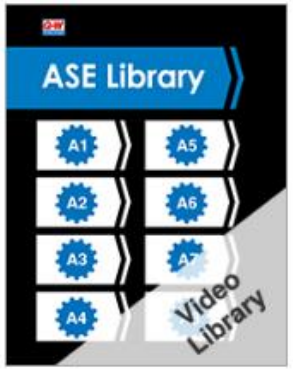
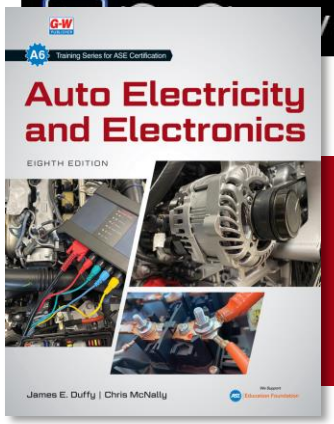


A6 - Auto Electricity and Electronics

- Ohm's Law (02:46)
- Using Wiring Schematics (02:36)
- Using Electrical Test Equipment (02:37)
- Electrical Test Light and Powered Probe (01:20)
- Common Electrical Problems (04:03)
- Diagnosing Parasitic Draw (02:15)
- Wire and Terminal Repair (02:29)
- Battery Testing and Inspection (02:26)
- Charging and Jump Starting (01:49)
- Hybrid High Voltage Battery Safety and Service (02:20)
- Starting System Testing and Service (02:20)
- Starting System Service (01:05)
- Charging System Testing and Service (02:21)
- Lighting System Inspection and Service (01:19)
- Removing and Installing a Door Panel (01:31)
- Warning Lights and Maintenance Indicators (01:55)
- Windshield Wiper Service (01:49)

Using Electrical Test Equipment



ASE Video Library

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Home Favorite History New Narrated Goodheart-Willcox

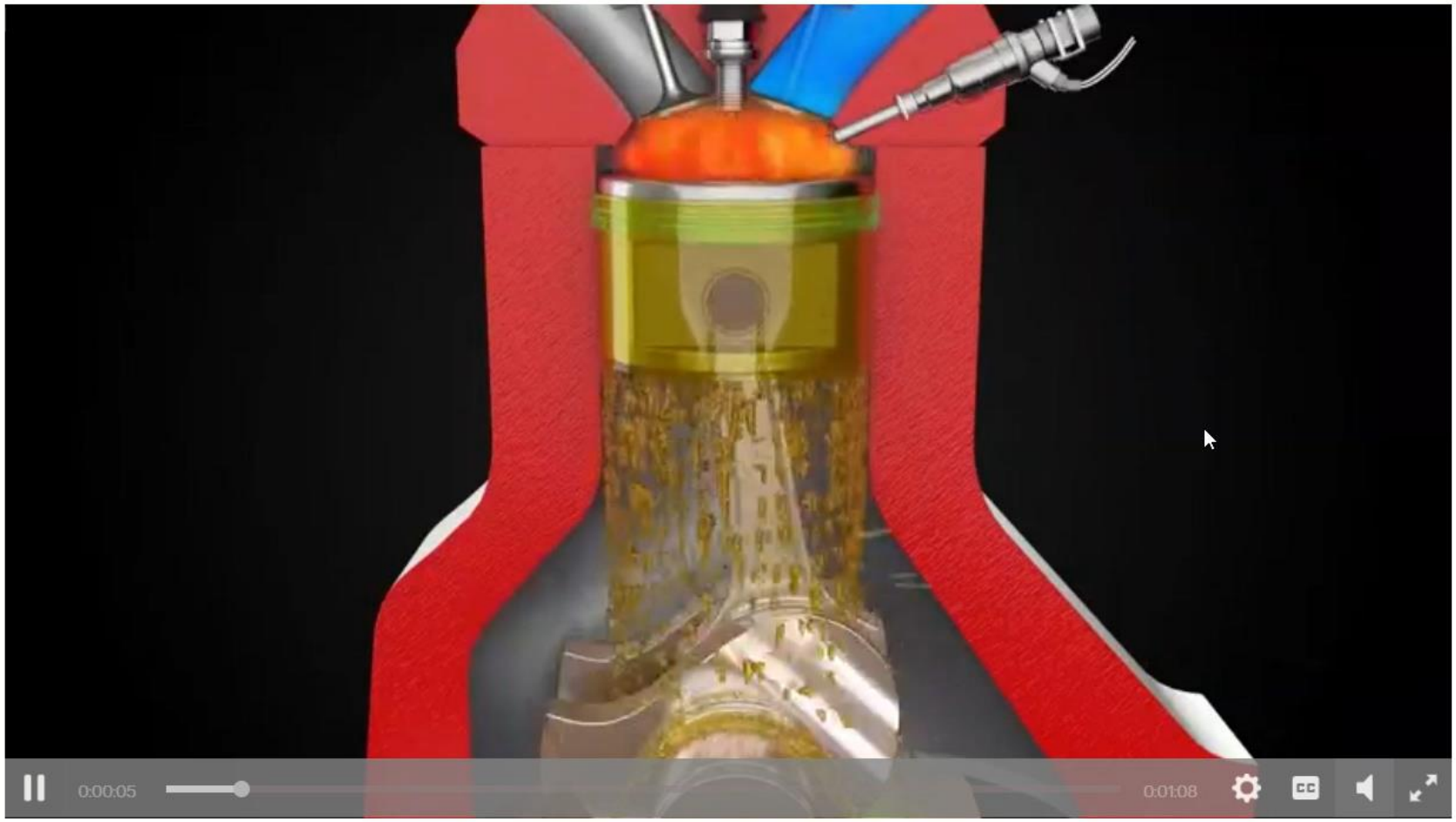
INTERACTIVE VIDEOS

Engine

Engine Oil System

Timing Belt

Timing Chain



NARRATED VIDEOS

Engine Oil S... 01:54

Timing Belt 01:17

Timing Chain

Engine

Basic Description

Internal combustion engines co
pistons, a crankshaft, and valve

MotoVisuals from Advance Auto Parts

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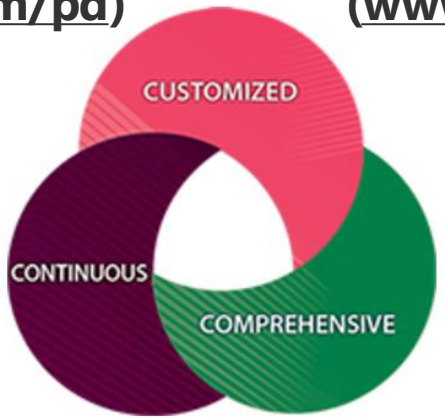

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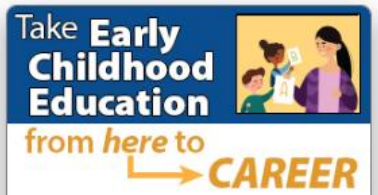

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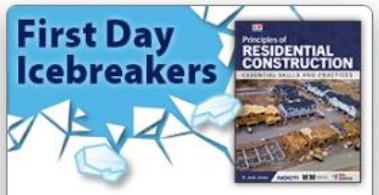

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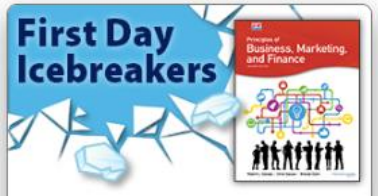

Snap, Clap, Pop: Business, Marketing, Finance

Type: Downloadable Activities
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Subject: Business, Marketing, and Finance

Snap, Clap, Pop: Health Science

Type: Downloadable Activities
Grade: 9-12
Subject: Health and Physical Education

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