Automotive Heating and Air Conditioning, 7e

Chapter 9 HVAC Electricity and Electronics

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of **Automotive Heating and Air Conditioning, 7e.** It correlates material to task lists specified by ASE and NATEF.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.	Explain the chapter learning objectives to the students. 1. Prepare for the ASE Heating and Air Conditioning (A7) certification test content area "A" (A/C System Service, Diagnosis and Repair). 2. Explain the characteristics of electricity. 3. Differentiate between conductors, insulators, and semiconductors. 4. Explain the units of electrical measurement. 5. List the parts of a complete circuit. 6. Discuss the types of electrical circuit faults. 7. Explain how to detect and measure electrical voltage, current, and resistance using digital meters. 8. Discuss wire repair. 9. Discuss the purpose of terminals, connectors, relays, and switches. 10. Discuss networks and network classifications.
Establish the Mood or Climate	Provide a *WELCOME,* Avoid put downs and bad jokes.
Complete Essentials	Restrooms, breaks, registration, tests, etc.
Clarify and Establish Knowledge Base	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

ICONS	Ch09 HVAC Electricity and Electronics
	1. SLIDE 1 HVAC ELECTRICITY/ELECTRONICS 2. SLIDES 2-4 EXPLAIN OBJECTIVES
	Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED
	5. SLIDE 5 EXPLAIN Characteristics of Electricity 6. SLIDE 6 EXPLAIN Figure 9–2 nucleus of an atom has a positive (+) charge and the surrounding electrons have a negative (–) charge.
	ELECTRON FLOW
	DISCUSSION: DISCUSS ELECTRON ORBIT AROUND NUCLEUS & SHELLS ELECTRONS ORBIT WITHIN. HOW MANY SHELLS FORM AROUND A NUCLEUS? DISCUSS VALENCE RING & HOW MOVEMENT OF ELECTRONS FROM THIS RING CREATES CURRENT. DESCRIBE DIFFERENCE BETWEEN FREE & BOUND ELECTRONS.
	DEMONSTRATION: USE MAGNETS TO DEMO HOW OPPOSITES FORCES ATTRACT AND LIKE FORCES REPEL. SHOW HOW MAGNETS ATTRACT & REPEL EACH OTHER DEPENDING ON POLE ORIENTATION
	7. SLIDE 7 EXPLAIN Conductors, Insulators, Semiconductors 8. SLIDE 8 EXPLAIN Figure 9–7 Insulators are elements with five to eight electrons in the outer orbit.
	DISCUSSION: DISCUSS DIFFERENT CONDUCTORS. WHY IS COPPER MOST COMMONLY USED CONDUCTOR IN ELECTRICAL SYSTEMS?
	DISCUSSION: DISCUSS INSULATORS & REASON THEY MAKE POOR CONDUCTORS. WHAT IS RELATIONSHIP BETWEEN NUMBER OF ELECTRONS AN INSULATOR MATERIAL HAS & ITS ABILITY TO ACQUIRE & RELEASE ELECTRONS?

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	HANDS-ON TASK: HAVE BATTERY CABLES AND COMMON ELECTRICAL WIRING AVAILABLE TO PROVIDE STUDENTS A HANDS-ON EXPERIENCE WITH DIFFERENCES IN RESISTANCE THAT RESULT FROM CONDUCTORS OF DIFFERENT LENGTHS, DIAMETERS, AND MATERIALS.
	9. SLIDE 9 EXPLAIN Electrical Measurement **10. SLIDE 10 EXPLAIN** Parts of a Complete Circuit
DEMO	**DEMONSTRATION: SHOW HOW DMM MEASURES VOLTAGE. USE TRAINER TO SHOW STUDENTS MEASURING VOLTAGE**
	OHM'S LAW, CURRENT OHM'S LAW, RESISTANCE OHM'S LAW, VOLT
DEMO	**DEMONSTRATION: SHOW HOW DMM MEASURES VOLTAGE. USE PROJECT BOARD TO SHOW MEASURING RESISTANCE**
QUESTION	**DISCUSSION: HAVE STUDENTS TALK ABOUT RESISTANCE TO ELECTRON FLOW, OR OHMS. HOW DOES MATERIAL USED AS A CONDUCTOR AFFECT RESISTANCE?**
	MEASURE AC RIPPLE MEASURE BATTERY VOLTAGE DROP METER USAGE BATTERY VOLT CHECK METER USAGE CHECK CAN CIRCUIT METER USAGE MEASURE AMPS METER USAGE MEASURE FREQUENCY METER USAGE MEASURE OHMS METER USAGE MEASURE VOLTS METER USAGE TESTING DIODE
	11. SLIDE 11 EXPLAIN Figure 9–16 return path back to the battery can be any electrical conductor, such as a copper wire or the metal frame or body of the vehicle.

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	DISCUSSION: DISCUSS GROUND PATH. WHY DOESN'T A SEPARATE GROUND WIRE HAVE TO BE RUN FROM BATTERY TO EACH ELECTRICAL LOAD? DISCUSS HOW AND WHY A SHORT-TO-VOLTAGE OCCURS. WHAT IS THE REASON THAT SHORT-TO-VOLTAGE MAY OR MAY NOT BLOW A FUSE?
	12. **SLIDES 12-13 EXPLAIN** Types of Electrical Circuit Faults
DEMO	**DEMONSTRATION:** DEMONSTRATE BASIC ELECTRICAL CIRCUIT ON TRAINER. SHOW (FIGURE 4-1)WHAT HAPPENS WHEN CIRCUIT IS SHORTED TO GROUND
	TRAINER TASK: ALLOW STUDENTS TO BLOW FUSE BY CREATING A SHORT CIRCUIT, OBSERVING WHAT IT TAKES TO CREATE SHORT CIRCUIT AND WHAT RESULTS ARE FOUND
	14. **SLIDE 14 EXPLAIN** Detecting and Measuring Electrical Voltage, Current, and Resistance 15. **SLIDE 15 EXPLAIN Figure 9–31** Using a digital multimeter set to read ohms (Ω) to test this light bulb. The meter reads the resistance of the filament.
We Support NATEF	STUDENTS DO NATEF TASK SHEET DEMONSTRATE PROPER USE OF DIGITAL MULTIMETER (DMM) DURING DIAGNOSIS OF ELECTRICAL CIRCUIT PROBLEMS, INCLUDING: SOURCE VOLTAGE, VOLTAGE DROP, CURRENT FLOW, & RESISTANCE
	16. **SLIDES 16-17 EXPLAIN** Wire Repair 18. **SLIDES 18-19 EXPLAIN** Terminals, Connectors, Relays, and Switches 20. **SLIDE 20 EXPLAIN Figure 9–37** Some terminals have seals attached to help seal the electrical connections.
	VIDEO: WIRING HARNESS INSTALLATION http://media.pearsoncmg.com/ph/chet/chet_mylabs/akamai/template/video640x480.php?title=Wiring%20Harness%20Installation&clip=pandc/chet/2012/automotive/Installing_EFI_System/T12CD9.mov&caption=chet/chet_mylabs/akamai/2012/automotive/Installing_EFI_System/xml/T12CD9.xml
	VIDEO: FUSES & CIRCUIT BREAKERS VIDEO HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLABS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=FUSES%20AND%20CIRCUIT%20BREAKERS&CLIP=PANDC/CHET/2012/AUTOMOTIVE/AUTO_SHOP_SAFETY/CLIP18FUSES1.MOV&CAPTION=CHET/CHET_MYLABS/AKAMAI/2012/AUTOMOTIVE/AUTO_SHOP_SAFETY/XML/CLIP18FUSES1.XML

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	SOME WIRE GAUGES HAVE BOTH AWG & METRIC SCALES
QUESTION	**DISCUSSION:** HAVE THE STUDENTS TALK ABOUT THE DIFFERENT COLORS FOR AMPERAGE RATINGS. WHY ARE COLORS A GOOD IDEA?
QUESTION	**DISCUSSION:** DISCUSS PROCESS OF SOLDERING WIRES AND THE TYPE OF SOLDER USED. WHAT DO THE PERCENTAGES OF EACH ALLOY IN A SOLDER DETERMINE?
DEMO	**DEMONSTRATION:** DEMONSTRATE USE OF A SOLDERING IRON TO CONNECT WIRING. POINT OUT TO THE STUDENTS THAT THEY SHOULD MAKE SURE THAT THE SOLDER JOINT IS SMOOTH; OTHERWISE, A SHARP POINT COULD PUNCTURE SHRINK WRAP AND CAUSE A SHORT CIRCUIT
We Support NATEF	OPTIONAL: NATEF TASK SHEET REMOVE AND REPLACE TERMINAL END FROM CONNECTOR; REPLACE CONNECTORS AND TERMINAL ENDS
We Support NATEF	OPTIONAL: NATEF TASK SHEET REPAIR WIRING HARNESS (INCLUDING CAN/BUS SYSTEMS)
We Support NATEF	OPTIONAL: NATEF TASK SHEET PERFORM SOLDER REPAIR OF ELECTRICAL WIRING
	21. **SLIDE 21 EXPLAIN** Networks and Network Classification 22. **SLIDE 22 EXPLAIN Figure 9–54** A typical BUS system showing module CAN communications and twisted pairs of wire.
	23. **SLIDES 23-25 EXPLAIN Summary**