DOCUMENT RESUME

ED 197 157 CE 027 787

AUTHOR Belcher, Herb: Carey, John
TITLE Mountain Plains Learning Experience Guide: Electrical Theory. Course: Basic Electricity.
INSTITUTION Mountain-Plains Education and Economic Development Program, Inc., Glasgow AFB, Mont.
SPONS AGENCY Office of Vocational and Adult Education (ED), Washington, D.C.
BUREAU NO 498MH90008
PUB DATE May 79
CONTRACT 300-79-0153
NOTE 92p.: Some pages will not reproduce well due to broken print. For related documents, see CE 027 766.

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS Adult Education: Disadvantaged: Electrical Occupations: Electric Circuits: Electricians: *Electricity: Family Programs: *Individualized Instruction: Instructional Materials: Learning Activities: Learning Modules: Postsecondary Education: *Vocational Education
IDENTIFIERS *Alternating Current: *Direct Current: Mountain Plains Program

ABSTRACT

This individualized course on basic electricity covers the basic ideas of direct current and alternating current electricity. The course is comprised of two units: (1) Electrical Theory "B," and (2) Electrical Theory "A." Each unit is comprised of Learning Activity Packages (LAP) that provide specific information for completion of a learning activity. Each LAP contains the following parts: introduction, overview, skill competency, discussion, demonstration, performance, evaluation, and summary. The course is preceded by a pretest which is designed to direct the student to units and performance activities. (LRA)

MOUNTAIN PLAINS LEARNING EXPERIENCE GUIDE:

Electrical Theory.

Course: Basic Electricity.

Family Education Program

File Code: 761.00.00.00

Date Published: 5-23-79

Learning Experience Guide

COURSE: BASIC ELECTRICITY

DESCRIPTION:

This course covers the basic ideas of D.C. and A.C. electricity. It will help you understand the theory of the basic electrical circuit.

RATIONALE:

The basic electricity course will provide you with practical and theoretical information for use in Appliance Servicing, Electrical Wiring, Motor Repair and Heating, Refrigeration and Air Conditioning.

OBJECTIVES:

After completing this course you should be able to proceed into the various electrical fields and become proficient in the theory of operation and be able to diagnose problems of the equipment associated with your area of expertise.

PREREQUISITES:

Foundation Education skills.

RESOURCES:

The basic resource is "Basic Electricity for Appliances", Whirlpool Corporation, plus other filmstrips, tapes, pamphlets and handouts.

GENERAL INSTRUCTIONS:

This course contains fifteen (15) LAPs. Each LAP contains specific information for the completion of that learning activity. The student will start with LAP #1, read through it, do the tasks that are specified, and take a written and/or performance test. Upon successful completion of LAP #1, the student may continue on to each succeeding LAP and repeat the procedure used in LAP #1.

Principal Author(s): Herb Belcher

Student: _____ File Code: 761.01.00.00

Date: _____ Date Published: 5-24-79

Family Education Program

COURSE PRETEST: ELECTRICAL THEORY

1. If there is a different amount of electrical charge between two points, it is called:

   a. voltage
   b. potential difference
   c. both of the above

2. A good conductor of electricity is:

   a. pure water
   b. mineral oil
   c. copper
   d. silk

3. Electromotive force is defined as "the force that moves electrons." It is called:

   a. volts.
   b. ohms.
   c. amps.

4. Anything that offers opposition to the flow of current is said to have:

   a. voltage
   b. resistance
   c. amperage

5. When the temperature of a metal conductor is lowered, its resistance to current flow decreases.

   a. True
   b. False

6. The resistance of a conductor to the flow of electricity is determined by its:

   a. length
   b. cross-sectional area
   c. type of material
   d. temperature
   e. all of the above

7. Resistors are normally used in electrical circuits to:

   a. create voltage drop
   b. create voltage increase

8. Current passing through a single wire will set up magnetic lines of force surrounding the wire.

   a. True
   b. False

9. When a moveable iron core is placed inside a coil, the magnetic lines of force:

   a. repel the core.
   b. try to center the core in the coil.
   c. are cancelled out.

10. The voltage potential of A.C. current:

   a. continaully cycles from zero to minimum voltage.
   b. reverses polarity during each complete cycle.
   c. can be represented by a curve.
   d. all of the above.

11. A transformer may be used to step down voltage of:

   a. either AC or DC current
   b. only DC current
   c. only AC current
   d. AC and pulsating DC currents

12. An ohmmeter is a DC meter powered by a:

   a. milliamp
   b. battery
   c. resistor

13. Voltmeters are always connected:

   a. in series with the circuit.
   b. across the circuit.

14. AC batteries may only be used in AC circuits.

   a. True
   b. False

15. A generator for AC voltage is often called a:

   a. self-exciting dynamo
   b. excitor
   c. alternator

16. The rotor of an induction motor is caused to rotate by:

   a. induced current from the field windings.
   b. brushes contacting the commutator.
   c. the slip rings.

17. A single phase motor has two windings. How many windings would a three phase motor have:

   a. 5
   b. 3
   c. 4

18. A wrong run capacitor will allow the motor to start but will affect its efficiency:

19. A capacitor analyzer is designed to:

    a. read power factor percentage.
    b. diagnose an "open" or a "shorted" capacitor.
    c. read the microfarad rating of a capacitor.
    d. all of the above.

20. Multi-speed motor start at normal speed and switch down to a lower speed by the action of the:

    a. windings.
    b. centrifugal switch.

21. The start winding of an automatic washer motor is taken out of the circuit by a:

    a. .relay
    b. centrifugal switch
    c. capacitor.

22. A house meter measures the _____ passing through it into the house.

    a. amperage
    b. voltage
    c. wattage

23. Fuses and circuit breakers are devices which melt or automatically break a circuit when more _____ than it can carry attempts to pass.

    a. voltage
    b. amperage

24. A 240 volt, 3 wire circuit may be split into two 120 volt circuits at any point.

    a. True
    b. False

25. A fluorescent light goes out 120 times per second.

    a. True
    b. False

26. To minimize flickering, fluorescent lamps are usually in pairs with a ballast to cause a:

    a. phase difference
    b. current limiting between the two bulbs.

COURSE PRETEST ANSWER KEY: ELECTRICAL THEORY

1. C
2. C
3. A
4. B
5. A
6. E
7. A
8. A
9. B
10. D
11. D
12. B
13. B
14. B
15. C
16. A
17. B
18. A
19. D
20. B
21. B
22. C
23. B
24. A
25. A
26. A

Student: _____ File Code: 761.01.00.00

Date: _____ Date Published: 5-24-79

Family Education Program

COURSE POST TEST: ELECTRICAL THEORY

1. If there is a different amount of electrical charge between two points, it is called:

   a. voltage
   b. potential difference
   c. both of the above

2. A good conductor of electricity is:

   a. pure water
   b. mineral oil
   c. copper
   d. silk

3. Electromotive force is defined as "the force that moves electrons." It is called:

   a. volts.
   b. ohms.
   c. amps.

4. Anything that offers opposition to the flow of current is said to have:

   a. voltage
   b. resistance
   c. amperage

5. When the temperature of a metal conductor is lowered, its resistance to current flow decreases.

   a. True
   b. False

6. The resistance of a conductor to the flow of electricity is determined by its:

   a. length
   b. cross-sectional area
   c. type of material
   d. temperature
   e. all of the above

7. Resistors are normally used in electrical circuits to:

   a. create voltage drop
   b. create voltage increase

8. Current passing through a single wire will set up magnetic lines of force surrounding the wire.

   a. True
   b. False

9. When a moveable iron core is placed inside a coil, the magnetic lines of force:

   a. repel the core.
   b. try to center the core in the coil.
   c. are cancelled out.

10. The voltage potential of A.C. current:

   a. continaully cycles from zero to minimum voltage.
   b. reverses polarity during each complete cycle.
   c. can be represented by a curve.
   d. all of the above.

11. A transformer may be used to step down voltage of:

   a. either AC or DC current
   b. only DC current
   c. only AC current
   d. AC and pulsating DC currents

12. An ohmmeter is a DC meter powered by a:

   a. milliamp
   b. battery
   c. resistor

13. Voltmeters are always connected:

   a. in series with the circuit.
   b. across the circuit.

14. AC batteries may only be used in AC circuits.

   a. True
   b. False

15. A generator for AC voltage is often called a:

   a. self-exciting dynamo
   b. excitor
   c. alternator

16. The rotor of an induction motor is caused to rotate by:

   a. induced current from the field windings.
   b. brushes contacting the commutator.
   c. the slip rings.

17. A single phase motor has two windings. How many windings would a three phase motor have:

   a. 5
   b. 3
   c. 4

18. A wrong run capacitor will allow the motor to start but will affect its efficiency:

   a. True b. False

19. A capacitor analyzer is designed to:

    a. read power factor percentage.
    b. diagnose an "open" or a "shorted" capacitor.
    c. read the microfarad rating of a capacitor.
    d. all of the above.

20. Multi-speed motor start at normal speed and switch down to a lower speed by the action of the:

    a. windings.
    b. centrifugal switch.

21. The start winding of an automatic washer motor is taken out of the circuit by a:

    a. relay
    b. centrifugal switch
    c. capacitor.

22. A house meter measures the _____ passing through it into the house.

    a. amperage
    b. voltage
    c. wattage

23. Fuses and circuit breakers are devices which melt or automatically break a circuit when more _____ than it can carry attempts to pass.

    a. voltage
    b. amperage

24. A 240 volt, 3 wire circuit may be split into two 120 volt circuits at any point.

    a. True
    b. False

25. A fluorescent light goes out 120 times per second.

    a. True
    b. False

26. To minimize flickering, fluorescent lamps are usually in pairs with a ballast to cause a:

    a. phase difference
    b. current limiting between the two bulbs.

COURSE POST TEST ANSWER KEY: ELECTRICAL THEORY

1.	C
2.	C
3.	A
4.	B
5.	A
6.	E
7.	A
8.	A
9.	B
10.	D
11.	D
12.	B
13.	B
14.	B
15.	C
16.	A
17.	B
18.	A
19.	D
20.	B
21.	B
22	C
23.	B
24.	A
25.	A
26.	A

File Code: 761.01.01.01

Date Published: 5-23-79

Family Education Program

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Basic Electric Circuit

INTRODUCTION:

This LAP will cover nature of matter, structure of the atom, EMF, resistance and current.

OVERVIEW:

To service electrical appliance with proficiency, a technician must know basic electricity. What it is, how it is produced, how to measure it, how it makes different circuits operate.

SKILL COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Know different types of electricity.
2. Read wiring diagram symbols.
3. Be able to recognize basic series and parallel circuits.

DISCUSSION:

Listen to tape lesson #1 and #2. Study pages 7-31 in, "Basic Electricity for Appliances" (Whirlpool Corporation, Howard W. Sams and Company, Inc., Indianapolis, Indiana). Study symbols on page 23 and the handout on symbols. Answer questions and problems after each summary.

DEMONSTRATION:

The instructor will introduce the student to various electrical components.

PERFORMANCE:

Handout experiment.

EVALUATION:

Notify the instructor when you are ready to take the written test. All items should be accomplished successfully.

Principal Author(s): Herb Belcher, John Carey

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. Basic nature of electricity.
2. Basic parts of an electric circuit.
3. Basic wiring symbols.
4. The effect of different resistance combinations on current and voltage.

Upon successful completion of this LAP, proceed to the next LAP.

Family Education Program

File Code: 761.01.01.02

Date Published: 5-23-79

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Simpson 260

INTRODUCTION:

This LAP will cover the use of a multimeter Simpson 260.

OVERVIEW:

A service technician has to know how to use a multimeter to properly diagnosis electrical problems in an electrical circuit.

SKILL COMPETENCY:

Upon successful completion of this LAP you will be able to do the following:

1. Know how to operate a multimeter properly.
2. Measure resistance.
3. Measure A.C. voltage.
4. Measure D.C. voltage.
5. Measure D.C. current

DISCUSSION:

Study handout given on Simpson 260 and pages 78-85 in "Basic Electricity for Appliances" (Whirlpool Corporation, Howard W. Sams and Company, Inc., Indianapolis, Indiana). Study handout on resistor color codes. Review video tape on powers of ten.

DEMONSTRATION:

Have your instructor go over proper use of Simpson 260 with you.

PERFORMANCE:

Check out a multimeter. Go to work station, do experiments on: A.C.-D.C. voltage measurements, current measurements. Do experiments #5, and #7 in "Electricity II" (Broadhead Garrett).

EVALUATION:

Upon successful completion of performance, notify your instructor that you are ready to take the written test. All items should be accomplished successfully.

Principal Author(s): Herb Belcher, John Carey

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. How to properly operate a multimeter.
2. How to measure resistance.
3. How to measure A.C.-D.C. voltage.
4. How to measure D.C. current.

Upon successful completion of this LAP, proceed to the next LAP.

File Code: 761.01.01.03

Date Published: 5-23-79

Family Education Program

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Power Wheel

INTRODUCTION:

This LAP will cover OHMS law and WATT's law. There is no prerequisite other than successful completion of the previous LAPs.

OVERVIEW:

To be able to fully understand the relation of volts, current, resistance and power. To understand and troubleshoot a circuit.

SKILL COMPETENCY:

Upon successful completion of this LAP you will be able to do the following:

1. Successful use multimeter as a troubleshooting device.
2. Understand circuits.

DISCUSSION:

Listen to tape covering lesson #3. Read pages 32-38 in "Basic Electricity for Appliances" (Whirlpool Corporation, Howard W. Sams and Company, Inc., Indianapolis, Indiana). Answer questions and problems after each summary.

DEMONSTRATION:

Proper use of watt meter by instructor.

PERFORMANCE:

Do experiments on OHMS and WATTS law in "Electricity II", (Broadhead Garrett) -- 8, 9, 10, 11, and 14.

EVALUATION:

Notify the instructor when you are ready to take the written test. Have the instructor evaluate your performance test. All items should be accomplished successfully.

Principal Author(s): Herb Belcher, John Carey

SUMMARY:

Go over the test with the instructor. You should now understand:

1. OHMS Law
2. WATTS Law
3. Power wheel
4. House power

Upon successful completion of the tests, fill out the SPR and proceed to the next LAP.

Family Education Program

File Code: 761.01.01.04

Date Published: 5-23-79

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Magnetism

INTRODUCTION:

This LAP will cover basic magnetism, what it is, how it works, and how it is produced.

OVERVIEW:

Modern appliances and electrical equipment use coils and motors to function. To understand how these coils and motors operate, the student has to understand magnetism.

SKILL COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Know the difference between permanent magnets and electro-magnets.
2. Know how magnetic lines of force operate.
3. Know the different properties of magnetism.

DISCUSSION:

Listen to tape lesson #4. Read pages 39-54 in, "Basic Electricity for Appliances", (Whirlpool Corporation, Howard W. Sams and Company, Inc., Indianapolis, Indiana). Answer questions and problems after each summary.

DEMONSTRATION:

None at this time unless student is having problems.

PERFORMANCE:

Do the projects, "Lines of Force Around A Magnet", "Electromagnet Cannon", "A Simple Relay", in "Basic Electricity for Appliances" (Whirlpool) and experiments #19 and #20 in "Electricity II" (Broadhead Garrett).

EVALUATION:

Tell your instructor when you are ready to take the written test. Have your instructor check your performance work. All items must be accomplished successfully as assessed by your instructor.

Principal Author(s): Herb Belcher, John Carey

SUMMARY:

You should now understand the following:

1. How magnetic lines of force operate around a magnet.
2. How they are induced into an electromagnet.
3. Know what are good and poor conductors of magnetic lines.

Upon successful completion, record time on SPR and proceed to next LAP.

File Code: 761.01.01.05

Date Published: 5-24-79

Family Education Program

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Alternating Current

INTRODUCTION:

This LAP covers the basic alternator and how it produces electricity. It also covers capacitors, inductors, transformers and their basic functions.

OVERVIEW:

All electricity coming from the power company is A.C. A technician must know how A.C. functions to perform his job efficiently.

SKILL COMPETENCY:

Upon successful completion of this LAP, the student will be able to do the following:

1. Check capacitors and inductors.
2. Know functions of a transformer.
3. How electricity is produced in a generator.

DISCUSSION:

Listen to tape lesson #5. Read pages 61-78 in, "Basic Electricity for Appliances" (Whirlpool Corporation, Howard W. Sams and Company, Inc., Indianapolis, Indiana). Answer questions and problems after each summary.

DEMONSTRATION:

How to produce electricity by moving a conductor through a magnetic field.

PERFORMANCE:

Do experiments #24, #27, and #30 in, "Electricity II" (Broadhead-Garrett).

Principal Author(s): John Carey, Herb Belcher

EVALUATION:

Tell your instructor when you are ready to take the written test. Have your instructor check over your performance test. All items must be completed successfully as assessed by your instructor.

SUMMARY:

You should now understand the following:

1. What affects an inductor has on an electrical circuit.
2. What affects a capacitor has on an electrical circuit.
3. The turns ratio of transformer as it relates to current and voltage.

Upon successful completion, record time on SPR and proceed to the next LAP.

File Code: 761.01.01.06

Date Published: 5-24-79

Family Education Program

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Reactance and Power

INTRODUCTION:

This LAP covers the affects of capacitive reactance, inductive reactance, resistance on an electrical circuit. It also covers the relationship of apparent power and true power.

OVERVIEW:

Major appliances operate off of electrical motors. To understand how a motor runs, a technician must know and understand reactance and power.

SKILL COMPETENCY:

Upon successful completion of this LAP the student will be able to do the following:

1. Calculate true power from reactive power.
2. Know voltage current relationships in an inductive circuit, capacitor circuit and resistive circuit.

DISCUSSION:

Listen to tape lesson #6. Read pages 78-92 in "Basic Electricity for Appliances" (Whirlpool Corporation, Howard W. Sams and Company, Inc., Indianapolis, Indiana). Answer questions and problems after each summary.

DEMONSTRATION:

The instructor will use the watt meter in showing you the relationship between apparent power and true power.

PERFORMANCE:

Do "Variable Reactance Power Control" project in "Basic Electricity for Appliances" (Whirlpool). Do experiments #36, #37, #38, #43, #44 in "Electricity II" (Broadhead Garrett).

EVALUATION:

Tell your instructor when you are ready to take the written test. Have your instructor check over your performance test. All items must be accomplished successfully as assessed by your instructor.

Principal Author(s): Herb Belcher, John Carey

SUMMARY:

Have your instructor go over your written test with you. You should now understand the following:

1. Physical and electrical characteristics of capacitors, inductors and resistors.
2. Understand the relationship of reactive power and true power.

Upon successful completion, record time on SPR and proceed to the next LAP.

Family Education Program

File Code: 761.01.01.07

Date Published: 5-24-79

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Alternators and Generators

INTRODUCTION:

This LAP covers electromagnetic induction as it applies to generators and alternators. Single phase and three phase systems are also covered briefly.

OVERVIEW:

A student should know the difference between alternators and generators so he will be able to properly use the correct unit in an electrical configuration.

SKILL COMPETENCY:

Upon successful completion of this LAP, the student will be able to do the following:

1. Know the difference between an alternator and a generator.
2. Know the difference between D.C. electricity, single phase A.C. electricity, and multiple phase A.C. electricity.

DISCUSSION:

Listen to tape lesson #7. Read pages 93-97 in "Basic Electricity for Appliances" (Whirlpool Corporation, Howard W. Sams and Company, Inc., Indianapolis, Indiana). Answer questions and problems after each summary.

DEMONSTRATION:

The instructor will familiarize you with the operation of a simple motor.

PERFORMANCE:

Do experiment #40 in "Electricity II" (Broadhead Garrett).

EVALUATION:

Tell your instructor when you are ready to take the written test. Have your instructor check your performance test. All items must be accomplished successfully as prescribed by your instructor.

Principal Author(s): Herb Belcher, John Carey

SUMMARY:

Have your instructor go over your written test with you. You should now understand the following:

1. How D.C. electricity is produced.
2. How A.C. electricity is produced.
3. Single phase versus multiple phase electricity.

Upon successful completion, record your time on SPR and proceed to the next LAP.

Family Education Program

File Code: 761.01.01.08

Date Published: 5-24-79

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Motors

INTRODUCTION:

This LAP will cover the basic operation of various types of single phase and three phase motors.

OVERVIEW:

Motors are used in a majority of electrical apparatus. The student should become familiar with the operating characteristics of motors.

SKILL COMPETENCY:

Upon successful completion of this LAP, you will be able to:

1. Know how a motor operates.
2. Be able to identify different types of motors.
3. Have a basic knowledge of where the different types of motors are used.

DISCUSSION:

Listen to tape lesson #8 and #9. Read pages 99-111 in "Basic Electricity for Appliances" (Whirlpool Corporation, Howard W. Sams and Company, Inc., Indianapolis, Indiana). Answer questions and problems after each summary.

DEMONSTRATION:

No demonstration is needed unless the student is having difficulty.

PERFORMANCE:

Disassemble various motors and identify the parts. Check out and identify various motor windings with an ohmmeter. Use a jump start box to run and test a motor.

EVALUATION:

Tell your instructor when you are ready to take the written test. Have instructor check your performance work. All items are to meet the instructor's criteria.

Principal Author(s): Herb Belcher, John Carey

Family Training Center, Inc.

SUMMARY:

You should know and understand:

1. The theory of operation of electric motors.
2. How different types of motors operate and where they are used.

Upon successful completion of this LAP, record your time on your SPR and proceed to the next LAP.

File Code: 761.01.01.09

Date Published: 5-24-79

Family Education Program

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Motor Capacitor

INTRODUCTION:

This LAP will cover the function of a capacitor as it is applies in electric motors.

OVERVIEW:

Motor capacitors are used on the majority of motors. They also are a major cause of motor troubles. It is beneficial to be able to properly check and evaluate motor capacitors.

SKILL COMPETENCY:

Upon successful completion of this LAP you will be able to:

1. Properly use a capacitor analyzer.
2. How to properly size and replace motor capacitors.

DISCUSSION:

Listen to tape lesson #10. Read pages 111-117 in "Basic Electricity for Appliances" (Whirlpool Corporation, Howard W. Sams and Company, Inc., Indianapolis, Indiana). Answer questions and problems after each summary.

DEMONSTRATION:

The instructor will demonstrate how to properly use a capacitor analyzer.

PERFORMANCE:

Use a capacitor analyzer.

EVALUATION:

Tell your instructor when you are ready to take the written test. Have instructor check your performance work. All items to meet instructor's specifications.

SUMMARY:

You should now understand:

1. The purpose of a capacitor in a motor circuit.

Upon successful completion of this LAP, record your time on your SPR and proceed to next LAP.

Principal Author(s): Herb Belcher, John Carey

Family Education Program

File Code: 761.01.01.10

Date Published: 5-24-79

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Motor Controls

INTRODUCTION:

This LAP will cover various types of motor controls.

OVERVIEW:

Motor controls are an integral part of the motor and are the cause of a lot of motor malfunctions. Therefore, you should have a good knowledge of their functions.

SKILL COMPETENCY:

Upon successful completion of this LAP you will be able to:

1. Identify various kinds of motor controls.
2. Check and replace a motor control.

DISCUSSION:

Listen to tape lesson #11. Read pages 119-127 in "Basic Electricity for Appliances" (Whirlpool Corporation, Howard W. Sams and Company, Inc., Indianapolis, Indiana). Answer questions and problems after each summary.

DEMONSTRATION:

No demonstration is necessary unless the student is having difficulties.

PERFORMANCE:

Check out various types of motor controls with multimeter.

EVALUATION:

Tell your instructor when you are ready to take the written test. Have instructor check your performance work. All items are to meet instructor's specifications.

SUMMARY:

The student will have a working knowledge of different types of motor controls and how they work in the circuit.

Upon successful completion of this LAP, record your time on your SPR and proceed to the next LAP.

Principal Author(s): Herb Belcher, John Carey

File Code: 761.01.01.11

Data Published: 5-24-79

Family Education Program

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: National Electric Code

INTRODUCTION:

This LAP covers some basic electrical standards as set up by the National Board of Fire Underwriters.

OVERVIEW:

The "National Electric Code" is the standard of the electrical industry. The student should know some basic rules so that he may make minor electrical repairs correctly.

SKILL COMPETENCY:

Upon successful completion of this LAP, you will be able to:

1. Know the basic rules of the N.E.C.
2. Be able to make some minor electrical repairs.

DISCUSSION:

Listen to tape lesson #12. Read pages 129-142 in "Basic Electricity for Appliances" (Whirlpool Corporation, Howard W. Sams and Company, Inc., Indianapolis, Indiana). Answer questions and problems after each summary.

DEMONSTRATION:

The instructor will demonstrate some basic wiring practices as defined by the N.E.C.

PERFORMANCE:

1. Properly install various types of appliance cords.
2. Check out 110 volt and 220 volt receptacles.
3. Identify hot, neutral and ground wires in cords and receptacles.

EVALUATION:

Tell your instructor when you are ready to take the written test. Have instructor check your performance work. All items to be done according to standards.

SUMMARY:

The student will know some basic electrical standards as defined by the National Board of Fire Underwriters. Upon successful completion of this LAP, record your time on your SPR and proceed to the next LAP.

Principal Author(s): Herb Belcher, John Carey

Family Training Center, Inc.

File Code: 761.01.01.12

Date Published: 5-24-79

Family Education Program

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Heating and Lighting

INTRODUCTION:

This LAP covers a few methods of producing heat and light.

OVERVIEW:

Heating and lighting systems are a common item in electrical work. A student should become familiar with these items so he may properly diagnose a problem that may arise in this area.

SKILL COMPETENCY:

Upon successful completion of this LAP, you will be able to:

1. Identify various types of heating elements.
2. Identify various types of lighting systems.
3. Know the advantages and disadvantages of different heating and lighting systems.

DISCUSSION:

Listen to tape lesson #13. Read pages 143-161 in "Basic Electricity for Appliances" (Whirlpool Corporation, Howard W. Sams and Company, Inc., Indianapolis, Indiana). Answer questions and problems after each summary.

DEMONSTRATION:

No demonstration is necessary unless the student is having difficulty.

PERFORMANCE:

Check out various heating elements. Take apart, check out, and put together a fluorescent light.

EVALUATION:

Tell the instructor when you are ready to take the written test. Have your instructor check your performance work. All items are to meet minimum standards.

SUMMARY:

The student shall know a variety of ways to produce heat and light. Upon successful completion of this LAP, record your time on SPR and proceed to the next LAP.

Principal Author(s): Herb Belcher, John Carey

File Code: 761.01.01.13

Date Published: 5-24-79

Family Education Program

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Basic Wiring Symbols

INTRODUCTION:

This LAP will cover the basic symbols used in wiring diagrams.

OVERVIEW:

A student must understand wiring diagrams to properly evaluate the unit under study.

SKILL COMPETENCY:

Upon successful completion of this LAP, you will be able to read and understand wiring diagrams.

DISCUSSION:

Read pages 163 through 218 in "Basic Electricity for Appliances" (Whirlpool Corporation, Howard W. Sams and Company, Inc., Indianapolis, Indiana). Answer questions and problems after each summary.

DEMONSTRATION:

No demonstration is necessary unless student is having difficulty.

PERFORMANCE:

Be able to understand various wiring symbols. Be able to interpret different operating conditions on an automatic washer and dryer.

EVALUATION:

Tell your instructor when you are ready to take the written test. Have instructor check your performance work.

Principal Author(s): Herb Belcher, John Carey

SUMMARY:

You should know the basic wiring symbols and how to read an automatic washer wiring diagram and automatic dryer wiring diagram.

Upon successful completion of this LAP, proceed to the next LAP.

File Code: 761.01.01.14

Date Published: 5-24-79

Family Education Program

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Refrigerator Wiring Diagram

INTRODUCTION:

This LAP is a continuation of symbols used in wiring diagrams.

OVERVIEW:

The student must understand wiring diagrams of different units to properly understand how the unit functions.

SKILL COMPETENCY:

Upon successful completion of this LAP, the student will be able to read and diagnose the circuitry of a refrigerator.

DISCUSSION:

Read pages 223-226 in "Basic Electricity for Appliances", (Whirlpool Corporation, Howard W. Sams and Company, Inc., Indianapolis, Indiana). Answer questions and problems after each summary.

DEMONSTRATION:

No demonstration is necessary unless the student is having difficulties.

PERFORMANCE:

Be able to read, understand and diagnose the wiring diagrams of a refrigerator.

EVALUATION:

Tell your instructor when you are ready to take the written test. Have instructor check your performance work.

SUMMARY:

Your knowledge of reading and understanding wiring diagrams should increase. You should understand the wiring diagram of a refrigerator.

Upon successful completion of this LAP, you may proceed to the next LAP.

Principal Author(s): Herb Belcher, John Carey

Family Education Program

File Code: 761.01.01.15

Date Published: 5-24-79

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Defrost Circuits

INTRODUCTION:

This LAP is a continuation of wiring diagrams used in the electrical industry.

OVERVIEW:

The student must understand the wiring diagram of the unit under evaluation to properly solve the problem.

SKILL COMPETENCY:

Upon successful completion of this LAP, you will be able to read and understand the operation of a refrigerator defrost circuit.

DISCUSSION:

Read pages 227 through 238 in "Basic Electricity for Appliances" (Whirlpool Corporation, Howard W. Sams and Company, Inc., Indianapolis, Indiana). Answer questions and problems after each summary.

DEMONSTRATION:

No demonstration is necessary unless the student is having problems.

PERFORMANCE:

Be able to help solve any electrical problem associated with the unit under diagnosis from the wiring diagram.

EVALUATION:

Tell your instructor when you are ready to take the written test. Have instructor check your performance work.

SUMMARY:

Your knowledge of reading and understanding wiring diagrams should increase. You should understand the defrost circuit in a refrigerator.

Principal Author(s): Herb Belcher, John Carey

Family Training Center, Inc.

Student: _____ File Code: 761.01.01.00

Date: _____ Date Published: 5-24-79

Family Education Program

UNIT POST TEST: ELECTRICAL THEORY "B"

1. Impedance is the total opposition to current flow. It includes:

   a. resistance.
   b. inductive reactance.
   c. capacitive reactance.
   d. all of the above.

2. The voltage induced in a secondary coil is directly proportional to the number of turns in:

   a. the primary coil.
   b. the secondary coil.
   c. both coils.

3. When current and voltage pass through zero and maximum at the same instant, they are:

   a. alternating
   b. in phase
   c. lagging

4. A capacitive or a purely reactive circuit consumes no power. All power is returned to the source:

   a. True
   b. False

5. The movement of electrons between two points is called:

   a. voltage.
   b. current
   c. potential.

6. The rate of electron flow is measured in:

   a. amperes.
   b. volts.
   c. potential.

7. A full sine wave is accomplished by one complete revolution of an AC generator armature because each end of the armature loop is always connected to one end of the circuit.

   a. True
   b. False

8. If four lamps are wired in series and one lamp goes out, what is the effect on the other three?

   a. does not affect the others.
   b. the other three will glow brighter.
   c. all will go out.
   d. the other three will dim.

9. The resistance of any material depends on its:

   a. size.
   b. type of material.
   c. temperature.
   d. all of the above.

10. Where should range switch be set when meter is not in use? (WRITE ANSWER IN YOUR OWN WORDS): _____

_____

11. Using Ohm's Law, what is the amperage of a 120 volt circuit through a resistance of 60 ohms?

   a. 20 amps.
   b. 2 amps.
   c. .02 amps.

12. When only two resistors are parallel, the total resistance can be found with this formula: $R\ total = \frac{R_1 \times R_2}{R_1 + R_2}$. If R_1 is 82 ohms and R_2 is 56 ohms, what is the total resistance?

   a. 132
   b. 4727
   c. 33.27

13. If we want to find the wattage or power consumed by a resistance, the formula would be:

   a. $I \times R$
   b. $\frac{E}{R}$
   c. $E_2 \times I$
   d. $\frac{R^2}{E}$

14. There is no insulation for magnetism.

   a. True
   b. False

15. When a conductor is wound into a tight coil, the magnetic lines of force of the individual loops:

   a. form their own lines of force
   b. join and reinforce each other
   c. cancel each other

16. Heat produced by electricity can be controlled by changing the:

    a. voltage
    b. current
    c. resistance
    d. time
    e. any of the above

17. The most common method of electrical heating is by:

    a. resistance
    b. inductive
    c. dielectric

18. A 240 volt, 3 wire circuit may be split up into two 120 volt circuits at any point.

    a. True
    b. False

19. The National Electrical Code is:

    a. A strict national safety law
    b. A code of minimum standards

20. A hot wire can also be classed as _____ relay.

    a. an amperage
    b. a voltage

21. If the start winding of a single phase motor remains in the circuit it will:

    a. overheat and not get up to speed
    b. run too fast
    c. run backwards

22. Placing two capacitors in parallel with each other will equal a total of:

    a. the capacitance of the larger
    b. the sum of the two added together.
    c. the larger minus the smaller

23. A capacitor can hold a charge for a long time. It should be safely discharged by shorting the terminals with:

    a. a screwdriver
    b. a 20,000 ohm, 2 watt resistor
    c. a fuse

24. The start winding of a single-phase motor is wound with a _____ diameter wire than the run winding.

    a. larger
    b. smaller

25. The series or universal motor can be used on both AC and DC.

    a. True
    b. False

26. A generator would operate as a motor if current was applied to it.

    a. True
    b. False

27. A 240 volt single phase circuit is supplied to the modern house by the utility. House circuits may be connected to:

    a. L1 and L2 for 240 volts.
    b. L1 and Neutral for 120 volts.
    c. L2 and Neutral for 120 volts
    d. all of the above.

UNIT POST TEST ANSWER KEY: ELECTRICAL THEORY "B"

1. D
2. C
3. B
4. A
5. B
6. A
7. A
8. C
9. D
10. Transit position or highest voltage position
11. B
12. C
13. C
14. A
15. B
16. E
17. A
18. A
19. B
20. A
21. A
22. B
23. B
24. B
25. A
26. A
27. D

Student: _____ File Code: 761.01.01.00

Date: _____ Date Published: 5-24-79

Family Education Program

UNIT POST TEST: ELECTRICAL THEORY "A"

1. The movement of electrons between two points is called:

   a. voltage
   b. current
   c. potential

2. The rate of electron flow is measured in:

   a. amperes
   b. volts
   c. potential

3. If four lamps are wired in series and one lamp goes out, what is the effect on the other three?

   a. Does not affect the others.
   b. The other three will glow brighter.
   c. All will go out.
   d. The other three will dim.

4. The resistance of any material depends on its:

   a. size.
   b. type of material.
   c. temperature.
   d. all of the above.

5. Where should range switch be set when meter is not in use? _____

   _____

6. Using Ohm's Law, what is the amperage of a 120 volt circuit through a resistance of 60 ohms?

   a. 20 amps
   b. 2 amps
   d. .02 amps

7. When only two resistors are parallel, the total resistance can be found with this formula: $R_{total} = \frac{R_1 \times R_2}{R_1 + R_2}$. If R_1 is 82 ohms and R_2 is 56 ohms, what is the total resistance?

   a. 132
   b. 4727
   c. 33.27

8. If we want to find the wattage or power consumed by a resistance, the formula would be:

   a. $I \times R$
   b. $\frac{E}{R}$
   c. $E \times I$
   d. $\frac{R^2}{E}$

9. There is no insulation for magnetism.

   a. True
   b. False

10. When a conductor is wound into a tight coil, the magnetic lines of force of the individual loops:

    a. form their own lines of force.
    b. join and reinforce each other.
    c. cancel each other.

11. Impedance is the total opposition to current flow. It includes:

    a. resistance
    b. inductive reactance
    c. capacitive reactance
    d. all of the above

12. The voltage induced in a secondary coil is directly proportional to the number of turns in:

    a. the primary coil
    b. the secondary coil
    c. both coils

13. When current and voltage pass through zero and maximum at the same instant, they are:

    a. alternating
    b. in phase
    c. lagging

14. A capacitive or a purely reactive circuit consumes no power. All power is returned to the source.

    a. True
    b. False

15. A full sine wave is accomplished by one complete revolution of an AC generator armature because each end of the armature loop is always connected to one end of the circuit.

    a. True
    b. False

16. A 240 volt single phase circuit is supplied to the modern house by the utility. House circuits may be connected to:

    a. L1 and L2 for 240 volts.
    b. L1 and Neutral for 120 volts
    c. L2 and Neutral for 120 volts
    d. All of the above

17. A generator would operate as a motor if current was applied to it.

    a. True
    b. False

18. The series or universal motor can be used on both AC and DC:

    a. True
    b. False

19. The start winding of a single-phase motor is wound with _____ diameter wire than the run winding.

    a. larger
    b. smaller.

20. A capacitor can hold a charge for a long time. It should be safely discharged by shorting the terminals with:

    a. a screwdriver
    b. a 20,000 ohm, 2 watt resistor
    c. a fuse

21. Placing two capacitors in parallel with each other will equal a total of:

    a. the capacitance of the larger.
    b. the sum of the two added together.
    c. the larger minus the smaller.

22. If the start winding of a single phase motor remains in the circuit, it will:

    a. overheat and not get up to speed.
    b. run too fast.
    c. run backwards.

23. The hot wire relay can also be classed as _____ relay.

    a. an amperage.
    b. a voltage.

24. The National Electrical Code is:

    a. a strict national safety law.
    b. a code of minimum standards

25. A 240 volt, 3 wire circuit may be split up into two 120 volt circuits at any point.

    a. True
    b. False

26. The most common method of electrical heating is by:

    a. resistance
    b. induction
    c. dielectric

27. Heat produced by electricity can be controlled by changing the:

    a. voltage
    b. current
    c. resistance
    d. time
    e. any of the above

UNIT POST ANSWER KEY: ELECTRICAL THEORY "A"

1. B
2. A
3. C
4. D
5. Transit position or highest voltage position
6. B
7. C
8. C
9. A
10. A
11. D
12. C
13. B
14. A
15. A
16. D
17. B
18. A
19. B
20. B
21. B
22. A
23. A
24. B
25. A
26. A
27. E

Student: _____ File Code: 761.01.01.01

Date: _____ Date Published: 5-24-79

Family Education Program

LAP TEST: BASIC ELECTRIC CIRCUIT

1. The electron is the basic _____ charge of electricity.

   a. positive
   b. negative
   c. neutral

2. Electrons which are loosely bound to their nuclei are called:

   a. free
   b. orbital
   c. planetary
   d. all of the above

3. Matter with too few electrons is positively charged.

   a. True
   b. False

4. Matter with an excess of electrons is positively charged.

   a. True
   b. False

5. If there is a different amount of electrical charge between two points, it it called:

   a. voltage
   b. potential difference
   c. both of the above

6. The movement of electrons between two points is called:

   a. voltage
   b. current
   c. potential

7. The rate of electron flow is measured in:

   a. amperes
   b. volts
   c. potential

8. A good conductor of electricity is:

   a. pure water
   b. mineral oil
   c. copper
   d. silk

9. An electrical impulse travels through a conductor at a speed of nearly 186,000 _____ per second.

   a. feet
   b. miles

10. A positive charged object will _____ a negative charged object.

   a. attract
   b. repel

11. An electric circuit has at least four parts. Of the five listed, which one does NOT belong?

   a. a source of emf (voltage)
   b. a parallel resistance
   c. a set of conductors
   d. a load
   e. a means of control

12. The load of an electrical circuit may be any device that uses electricity.

   a. True
   b. False

13. Electromotive force is defined as "the force that moves electrons". It is called:

   a. volts
   b. ohms
   c. amps

14. If four lamps are wired in series and one lamp goes out, what is the effect on the other three?

   a. does not affect the others.
   b. the other three will glow brighter.
   c. all will go out.
   d. the other three will dim.

15. If four lamps are wired parallel and one lamp goes out, what is the effect on the other three?

   a. does not affect the others.
   b. the other three will glow brighter.
   c. all will go out.
   d. the other three will dim.

16. The measurement of the rate of flow of electrons between two points is in:

   a. volts
   b. amps
   c. ohms

17. The flow of electricity through a circuit can be compared to the flow of water through a pipe.

   a. True
   b. False

18. Resistance to the flow of electrons is measured in:

    a. volts
    b. amps
    c. ohms

19. Anything that offers opposition to the flow of current is said to have:

    a. voltage
    b. resistance
    c. amperage

20. The resistance of any material depends on its:

    a. size
    b. type of material
    c. temperature
    d. all of the above

LAP TEST ANSWER KEY: BASIC ELECTRIC CIRCUIT

1. B
2. D
3. A
4. B
5. C
6. B
7. A
8. C
9. B
10. A
11. B
12. A
13. A
14. C
15. A
16. B
17. A
18. C
19. B
20. D

Student: _____ File Code: 761.01.01.02

Date: _____ Date Published: 5-24-79

Family Education Program

LAP TEST: SIMPSON 260

1. Name three types of measurements that can be done with the Simpson 260:

   _____

   _____

   _____

2. Which scale on the meter reads backwards:

   a. D.C. scale
   b. A.C. scale
   c. Ohms scale

3. When measuring resistance in a circuit, what precaution should be taken?

   a. make sure the batteries in the meter are good.
   b. make sure the read lead is on the positive side of the resistor.
   c. make sure there is no power on the circuit.

4. When measuring unknown voltages with the multimeter, what precaution should be made?

   a. make sure you are reading the right scale.
   b. make sure the function switch is on the highest range.
   c. make sure the ohmmeter is zeroed.

5. To zero the ohmmeter you:

   a. touch the leads together and adjust the zero ohms knob until the needle is at the right end of the scale.
   b. touch leads together and adjust the zero ohms knob until the needle is at the left end of the scale.
   c. leave leads apart and adjust the zero ohms knob until the needle is at left end of the scale.

6. The four positions on the function switch are: (CIRCLE THE WRONG ANSWER)

   a. +A.C.
   b. -D.C.
   c. -A.C.
   d. +D.C.

7. You may measure the following with the test leads plugged in the common and + jacks in the lower left of meter. (CIRCLE THE WRONG ANSWER)

   a. D.C. volts
   b. D.C. milliamps
   c. 10 amps
   d. Ohms

8. Where should range switch be set when meter is not in use? (WRITE ANSWER IN YOUR OWN WORDS):

LAP TEST ANSWER KEY: SIMPSON 260

1. ohms, amps, D.C. voltage, A.C. voltage
2. C
3. C
4. B
5. A
6. C
7. C
8. Transit position or highest voltage position

Student: _____ File Code: 761.01.01.03

Date: _____ Date Published: 5-24-79

Family Education Program

LAP TEST: POWER WHEEL

1. Using Ohm's Law, what is the amperage of a 120 volt circuit through a resistance of 60 ohms?

   a. 20 amps
   b. 2 amps
   c. .02 amps

2. A 120 volt circuit has a load of 10 amps. What is the resistance of the load?

   a. 12 ohms
   b. 1.2 ohms
   c. .12 ohms

3. A load with a resistance of 40 ohms requires 3 amps of current to operate. What is the voltage required?

   a. 240
   b. 12
   c. 120
   d. 13.34

4. When the temperature of a metal conductor is lowered, its resistance to current flow decreases.

   a. True
   b. False

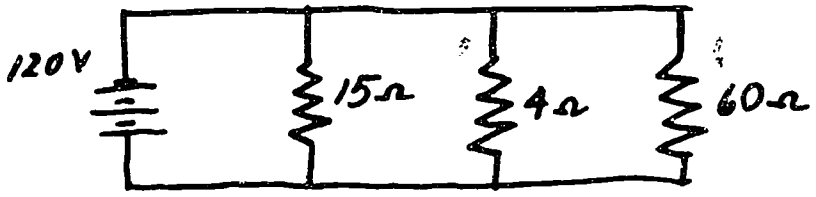
5. The resistance of a conductor to the flow of electricity is determined by its:

   a. length
   b. cross-sectional area
   c. type of material
   d. temperature
   e. all of the above

6. Resistors are normally used in electrical circuits to:

   a. create voltage drop
   b. create voltage increase.

7. What is the resistance of the combination of parallel resistors in this diagram?



   a. 26.33
   b. 3
   c. 39.5

8. When only two resistors are parallel, the total resistance can be found with this formula: $R_{total} = \frac{R_1 \times R_2}{R_1 + R_2}$. If R_1 is 82 ohms and R_2 is 56 ohms, what is the total resistance?

   a. 132
   b. 4727
   c. 33.27

9. Using the memory wheel, if we want to find the wattage or power consumed by a resistance, the formula would be:

   a. $I \times R$
   b. $\frac{E}{R}$
   c. $E \times I$
   d. $\frac{R^2}{E}$

10. One horsepower is always equal to 746 watts. A component using 746 watts will use how many kilowatts in 24 hours?

    a. 17.904
    b. 7.460
    c. 31.8

LAP TEST ANSWER KEY: POWER WHEEL

1. B
2. A
3. C
4. A
5. E
6. A
7. B
8. C
9. C
10. A

Student: _____ File Code: 761.01.01.04

Date: _____ Date Published: 5-25-79

Family Education Program

LAP TEST: MAGNETISM

1. Magnetic lines of force must form a loop in the space surrounding the magnet.

   a. True
   b. False

2. Iron and steel are the only metals that can be used for magnets.

   a. True
   b. False

3. The lines of force of a magnet always travel in a _____ path.

   a. stright line
   b. circular

4. There is no insulation for magnetism.

   a. True
   b. False

5. Current passing through a single wire will set up magnetic lines of force surrounding the wire.

   a. True
   b. False

6. When a conductor is wound into a tight coil, the magnetic lines of force of the individual loops:

   a. form their own lines of force
   b. join and reinforce each other
   c. cancel each other

7. When a movable iron core is placed inside a coil, the magnetic lines of force:

   a. repel the core.
   b. try to center the core in the coil.
   c. are cancelled out.

8. An electro magnet "a" with 100 turns of wire and another "b" with 200 turns have the same current applied:

   a. the "b" magnet is half as strong as "a"
   b. they both have the same strength
   c. "b" is twice as strong as "a"

9. Induced current may be produced by:

   a. passing a conductor through a magnetic field
   b. causing a magnetic field to build up and collapse in a current carrying adjacent conductor
   c. either of the above

10. The amount of voltage produced by a conductor passing through a magnetic field is determined by:

   a. the speed of the conductor
   b. the number of magnetic lines of force cut
   c. the number of conductors cutting the lines of flux
   d. all of the above

LAP TEST ANSWER KEY: MAGNETISM

1. A
2. B
3. B
4. A
5. A
6. B
7. B
8. C
9. C
10. D

Student: _____ File Code: 761.01.01.05

Date: _____ Date Published: 5-25-79

Family Education Program

LAP TEST: ALTERNATING CURRENT

1. The voltage potential of AC current:

   a. continually cycles from zero to maximum voltage
   b. reverses polarity during each complete cycle
   c. can be represented by a curve
   d. all of the above.

2. A generator generates voltage by _____ a conductor in a magnetic field.

   a. revolving
   b. maintaining

3. Inductive circuits produce more flux linkages when:

   a. the number of turns are increased
   b. the shape of the coil is changed
   c. the number of turns are decreased

4. The opposition to the changing current in an AC circuit is called:

   a. frequency
   b. inductive reactance
   c. induction

5. The opposition of a capacitor to the flow of current is called:

   a. frequency
   b. farad
   c. capacitive reactance

6. Impedance is the total opposition to current flow. It includes:

   a. resistance
   b. inductive reactance
   c. capacitive reactance
   d. all of the above

7. A transformer is a device using _____ to change the values of alternating current and voltage.

   a. induction
   b. capacitance
   c. impedance

8. Hysteresis loss in a transformer is caused by:

   a. heat of friction b. tightly wound wire c. shape of the coil

9. A transformer may be used to step down voltage of:

   a. either AC or DC current
   b. only DC current
   c. only AC current
   d. AC and pulsating DC currents

10. The voltage induced in a secondary coil is directly proportional to the number of turns in:

   a. the primary coil
   b. the secondary coil
   c. both coils

LAP TEST ANSWER KEY: ALTERNATING CURRENT

1. D
2. A
3. A
4. B
5. C
6. D
7. A
8. A
9. D
10. C

Student: _____ File Code: 761.01.01.06

Date: _____ Date Published: 5-25-79

Family Education Program

LAP TEST: REACTANCE AND POWER

1. An ohmmeter is a DC meter powered by a:

   a. milliamp
   b. battery
   c. resistor

2. Voltmeters are always connected:

   a. in series with the circuit
   b. across the circuit

3. Ammeters are always connected:

   a. in series with the circuit
   b. across the circuit

4. The combined effect of resistance, inductive reactance and capacitive reactance is called:

   a. reactive
   b. impedance
   c. capacitance

5. When current and voltage pass through zero and maximum at the same instant, they are:

   a. alternating
   b. in phase
   c. lagging

6. In a purely resistive circuit, voltage and current are in phase:

   a. true
   b. false

7. In an inductive circuit, the current:

   a. lags the voltage
   b. leads the voltage
   c. is in phase

8. In a reactive or capacitive circuit, the current:

   a. lags the voltage
   b. leads the voltage
   c. is in phase

9. A capacitive or a purely reactive circuit consumes no power. All power is returned to the source.

   a. true
   b. false

10. A resistance circuit consumes all the power and no power returns to the source.

   a. true
   b. false

LAP TEST ANSWER KEY: REACTANCE AND POWER

1. B
2. B
3. A
4. B
5. B
6. A
7. A
8. B
9. A
10. A

Family Education Program

LAP TEST: ALTERNATORS AND GENERATORS

1. A.C. batteries may only be used in AC circuits.

   a. True
   b. False

2. A generator must receive its mechanical energy from a prime mover such as:

   a. steam engine
   b. steam or air turbine
   c. gas or diesel engine
   d. an electric motor
   e. all of the above

3. A full sine wave is accomplished by one complete revolution of an AC generator armature because each end of the armature loop is always connected to one end of the circuit.

   a. True
   b. False

4. A DC generator develops a pulsating DC voltage because the ends of the armature loop continually reverse the connections to the circuit.

   a. True
   b. False

5. A generator for AC voltage is often called a:

   a. self-exciting dynamo
   b. exciter
   c. alternator

6. A 240 volt single phase circuit is supplies to the modern house by the utility. House circuits may be connected to:

   a. L1 and L2 for 240 volts
   b. L1 and Neutral for 120 volts
   c. L2 and Neutral for 120 volts
   d. all of the above

7. A three-phase system requires a minimum of three supply lines to the three phase load.

   a. True
   b. False

8. When three lines are used on a three-phase system, the return is made through:

   a. the other two in each phase
   b. a separate ground
   c. one of the other two

9. When six lines are used to a three-phase component:

   a. Each phase is as a single phase
   b. a single phase load can be connected to any one of the three phases
   c. both of the above are true

10. The loads of single phase components on a three-phase system should be balanced as close as possible across the three sets of coils in the alternator.

   a. True
   b. False

LAP TEST ANSWER KEY: ALTERNATORS AND GENERATORS

1. B
2. E
3. A
4. A
5. C
6. D
7. A
8. A
9. C
10. A

LAP TEST: MOTORS

1. A generator would operate as a motor if current was applied to it.

   a. True
   b. False

2. The alternating magnetic fields in an AC motor will cause the rotor to:

   a. laminate
   b. rotate
   c. conduct

3. The series or universal motor can be used on both AC and DC.

   a. True
   b. False

4. The rotor of an induction motor is caused to rotate by:

   a. induced current from the field windings.
   b. brushes contacting the commutator.
   c. the slip rings.

5. An induction motor in order to start and run must have three windings in the stator.

   a. True
   b. False

6. A three-phase installation is usually required when the motor load exceeds:

   a. 2 horsepower
   b. 5 horsepower
   c. 7 horsepower

7. A single phase motor has 2 windings. How many windings would a three phase motor have?

   a. 5
   b. 3
   c. 4

8. The timing sequence of the three phase voltages determines:

   a. the direction of rotation
   b. a very strong starting torque
   c. a highly efficient operation
   d. all of the above

9. A motor must have at least _____ windings for it to start electrically.

   a. one
   b. two
   c. three

10. A three phase motor costs _____ as a single phase of comparable size.

   a. less
   b. more
   c. the same

11. In a single-phase motor, the current will lag the voltage in the start winding due to:

   a. resistance
   b. inductance
   c. some inductance as well as resistance

12. When time is involved, such as when 60 cycles occur every second, the current flow would be termed a _____ current.

   a. 60 cycle
   b. 60 hertz

13. A coil will resist the starting of a flow of current. Once the flow has started there is:

   a. a tendency to stop.
   b. a tendency to continue.
   c. an increasing resistance to flow.

14. The compressing of a spring and letting it go is comparable to the impressing of voltage on a:

   a. resistor
   b. capacitor
   c. coil

15. When single-phase current is applied to parallel circuits, one containing a resistor and the other capacitor, it will result in two currents out of phase with each other.

   a. True
   b. False

16. The start winding of a single-phase motor is wound with a _____ diameter wire than the run winding.

   a. larger
   b. smaller

17. Once a motor is up to speed, the start winding switch opens. The transformer effect of the main winding will induce a current in the start winding.

   a. True
   b. False

18. The PSC or permanent split capacitor motor uses a run capacitor in series with the start winding and:

    a. it is removed from the circuit by a relay
    b. it is used only for starting
    c. it remains in the circuit

19. The start windings of shaded pole motors are not connected to the power source. The _____ action of the main winding furnishes the current.

    a. capacitor
    b. resistor
    c. transformer

20. Locked rotor voltage is the voltage available to the motor when it is _____ at instant of start.

    a. running
    b. not energized
    c. stalled

LAP TEST ANSWER KEY: MOTORS

1. A
2. B
3. A
4. A
5. B
6. B
7. B
8. D
9. B
10. A
11. C
12. B
13. B
14. B
15. A
16. B
17. A
18. C
19. C
20. C

Student: _____ File Code: 761.01.01.09

Date: _____ Date Published: 5-25-79

Family Education Program

LAP TEST: MOTOR CAPACITOR

1. A capacitor can hold a charge for a long time. It should be safely discharged by shorting the terminals with:

   a. a screwdriver
   b. a 20,000 ohm, 2 watt resistor
   c. a fuse

2. A capacitor analyzer is designed to:

   a. read power factor percentage
   b. diagnose an "open" or a "shorted" capacitor
   c. read the microfarad rating of a capacitor
   d. all of the above

3. Never replace a capacitor with one of a _____ voltage rating than the original.

   a. higher
   b. lower

4. Never replace a capacitor with another of a lower microfarad capacity or of a capacity higher than _____ above specifications.

   a. 15%
   b. 17%
   c. 10%

5. The use of a run capacitor of the wrong capacity will not allow the motor to start.

   a. True
   b. False

6. The wrong run capacitor will allow the motor to start but will affect its efficiency.

   a. True
   b. False

7. The use of a run capacitor rated higher than 10% over specifications will cause excessive amperage draw by the:

   a. run winding
   b. start winding
   c. both windings

8. A run capacitor rated too low will cause excessive amperage draw by the:

   a. run winding
   b. start winding
   c. both windings

9. Placing two capacitors in parallel with each other will equal a total of:

   a. the capacitance of the larger
   b. the sum of the two added together
   c. the larger minus the smaller

10. A start capacitor is placed in series with the start winding. The run capacitor is placed in series with the _____ winding.

   a. start
   b. run

LAP TEST ANSWER KEY: MOTOR CAPACITOR

1. B
2. D
3. B
4. C
5. B
6. A
7. B
8. A
9. B
10. A

Student: _____ File Code: 761.01.01.10

Date: _____ Date Published: 5-25-79

Family Education Program

LAP TEST: MOTOR CONTROLS

1. The start winding of an automatic washer motor is taken out of the circuit by a:

   a. relay
   b. centrifugal switch
   c. capacitor

2. If the start winding of a single phase motor remains in the circuit it will:

   a. overheat and not get up to speed.
   b. run too fast.
   c. run backwards.

3. Two-speed motors have:

   a. 2 windings
   b. 3 windings

4. Multi-speed motors start at normal speed and switch down to a lower speed by the action of the:

   a. windings
   b. centrifugal switch

5. The amperage relay and the potential relay are operated by _____ sensitivity.

   a. bimetal
   b. magnetic
   c. resistance

6. The coil of the amperage relay is in series with the main windings and is operated by the amperage draw while the motor is running.

   a. True
   b. False

7. The coil of the potential relay is _____ with the start winding.

   a. parallel
   b. in series

8. The hot wire can also be classed as _____ relay.

   a. an amperage
   b. a voltage

9. One switch may control more than one circuit.

   a. True
   b. False

10. A thermostatic switch may be controlled by:

   a. a bimetal
   b. a sealed hydraulic system
   c. either of the above

LAP TEST ANSWER KEY: MOTOR CONTROLS

1. B
2. A
3. B
4. B
5. B
6. B
7. A
8. A
9. A
10. C

Student: _____ File Code: 761.01.01.11

Date: _____ Date Published: 5-25-79

Family Education Program

LAP TEST: NATIONAL ELECTRIC CODE

1. Who supports the National Board of Fire Underwriters?

   a. fire insurance companies
   b. electrical manufacturers
   c. federal government

2. The National Electrical Code is:

   a. a strict national safety law
   b. a code of minimum standards

3. A separate receptacle should be installed for each laundry appliance because of:

   a. the load
   b. the conductor size
   c. the fuse capacity
   d. all of the above

4. A house meter measures the _____ passing through it into the house.

   a. amperage
   b. voltage
   c. wattage

5. Fuses and circuit breakers are devices which melt or automatically break a circuit when more _____ than it can carry attempts to pass.

   a. voltage
   b. amperage

6. It takes one fuse to protect either 120 volt or 240 volt circuits.

   a. True
   b. False

7. A time delay fuse can carry a load in excess of its rating for two minutes.

   a. True
   b. False

8. A hot wire is so called because it has a _____ to ground.

   a. connection
   b. potential

9. A 240 volt, three wire circuit may be split up into two 120 volt circuits at any point.

   a. True
   b. False

LAP TEST ANSWER KEY: NATIONAL ELECTRIC CODE

1. A, B
2. B
3. D
4. C
5. B
6. B
7. B
8. B
9. A

Student: _____ File Code: 761.01.01.12

Date: _____ Date Published: 5-25-79

Family Education Program

LAP TEST: HEATING AND LIGHTING

1. The most common method of electrical heating is by:

   a. resistance
   b. induction
   c. dielectric

2. Induced eddy currents flowing inside a metal object cause it to heat. This is called:

   a. resistance heating
   b. induction heating
   c. dielectric heating

3. An insulator placed between two oppositely charged plates causes a stress which produces heat. This heat is called:

   a. resistance heating
   b. induction heating
   c. dielectric heating

4. Heat produced by electricity can be controlled by changing the:

   a. voltage
   b. current
   c. resistance
   d. time
   e. any of the above

5. A fluorescent light goes out 120 times a second.

   a. True
   b. False

6. To minimize flickering, fluorescent lamps are usually in pairs with a ballast to cause a:

   a. phase difference
   b. current limiting between the two bulbs

7. Neon signs are a form of:

   a. hot cathode lighting
   b. cold cathode lighting

8. Mercury lamps produce light by passing current through a mercury vapor under vacuum.

   a. True
   b. False

9. An ion is an atom that has lost or gained electrons. One way that ionization is achieved in a gas is when _____ is applied.

   a. electrolyte
   b. voltage
   c. anode

10. Cathode rays are attracted by positive fields and repelled by negative fields.

   a. True
   b. False

LAP TEST ANSWER KEY: HEATING AND LIGHTING

1. A
2. B
3. C
4. E
5. A
6. A
7. B
8. B
9. B
10. A

Student: _____ File Code: 761.01.01.13

Date: _____ Date Published: 5-25-79

Family Education Program

LAP TEST: BASIC WIRING SYMBOLS

1. When the lid switch opens, the washer will not:

   a. spin
   b. fill with water
   c. advance the timer
   d. agitate

2. There are ____ solenoids shown on this diagram.

   a. 6
   b. 7
   c. 4

3. The water level switch controls the:

   a. water fill
   b. spin
   c. both

4. With the circled timer switches closed, the energized components are:

   a. the hot valve only.
   b. hot valve and lamp.
   c. hot valve, lamp and timer motor.

5. Now move the water fill switch "FULL. Circuits energized are:

   a. agitator solenoid, timer motor, hi-speed drive motor, lamp.
   b. timer motor, hi-speed motor, agitator solenoid.
   c. medium speed motor, timer motor, lamp.

6. The timer dial has been turned to the Regular" drying cycle. The "Push to Start" switch has not been pressed. The timer switches have been closed. Only the console lamp is energized.

   a. True
   b. False

7. Since the start switch has not been pressed, the buzzer will be energized.

   a. True
   b. False

8. If a voltmeter was attached to 1M and 2M on the centrifugal switch as shown, it would read:

   a. 0 volts
   b. 240 volts
   c. 120 volts

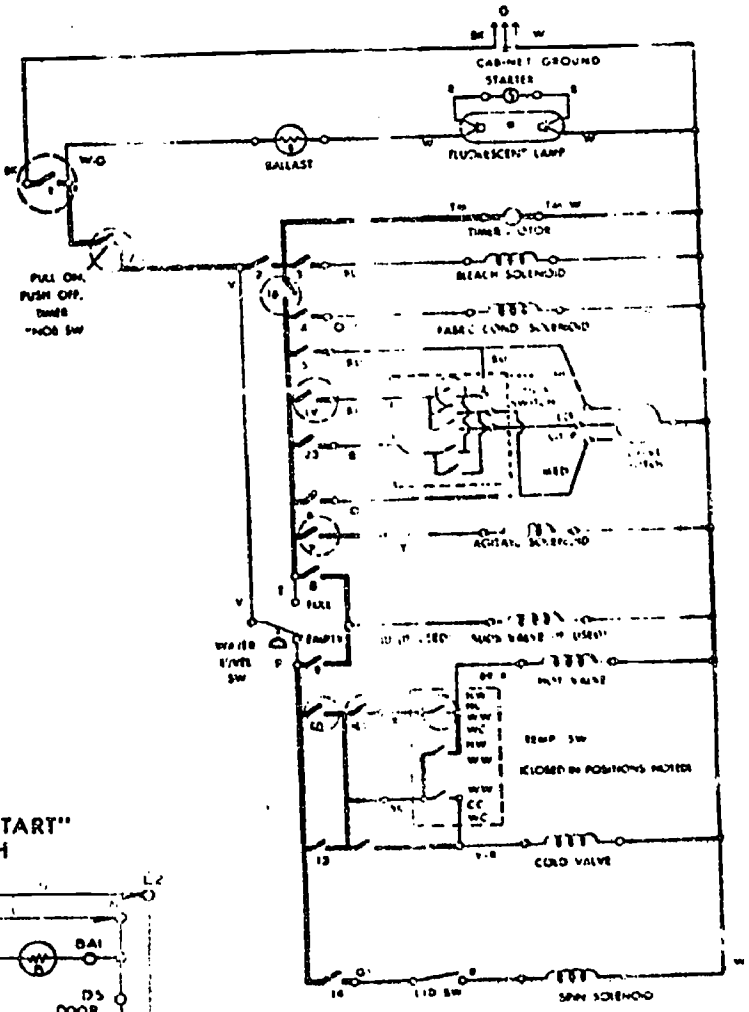
9. Attaching a voltmeter to T1 and T2 on the adjustable stat as shown, would find a voltage of:

   a. 0 volts
   b. 240 volts
   c. 120 volts

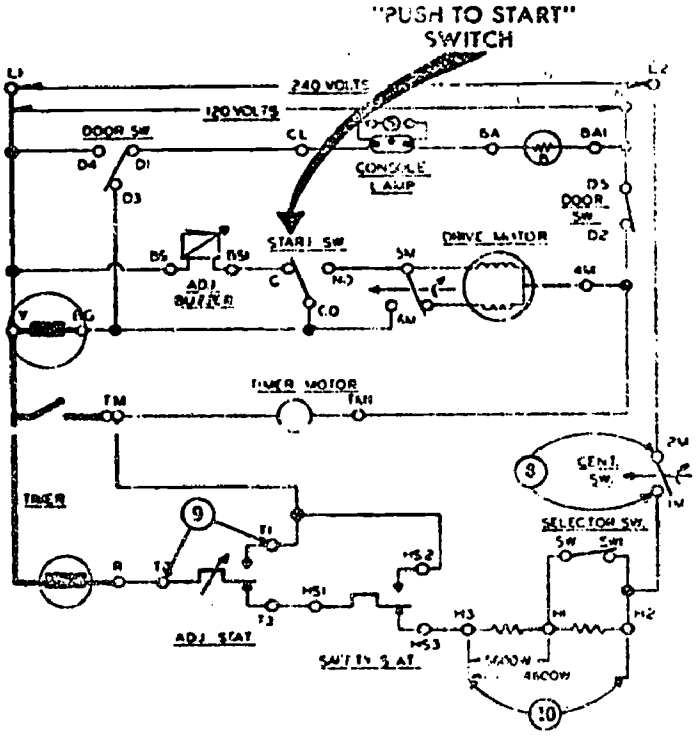
10. A selector switch bridges H 1 to H2 of the heating element. When the selector switch is opened, _____ _____ is generated by the heater between H1 and H2.

   a. more heat
   b. less heat

FOR QUESTIONS 1 - 5



FOR QUESTIONS 6 - 10



LAP TEST ANSWER KEY: BASIC WIRING SYMBOLS

1. A
2. B
3. C
4. B
5. A
6. A
7. B
8. B
9. C
10. B

Student: _____ File Code: 761.01.01.14

Date: _____ Date Published: 5-25-79

Family Education Program

LAP TEST: REFRIGERATOR WIRING DIAGRAM

1. An ohmmeter reading of the door switch in this diagram will indicate infinite resistance (no dial movement). (See second page of this LAP Test for diagram).

   a. True
   b. False

2. With the thermostat contacts open, the evaporator heater and the drain heater are energized.

   a. True
   b. False

3. When the thermostat contacts close, the evaporator heater and the drain heater are energized.

   a. True
   b. False

4. The arrow through the heat symbol of the thermostat indicates it to be:

   a. non-adjustable
   b. temperature operated
   c. adjustable

5. If the overload opens:

   a. the relay will not operate
   b. the compressor will not operate
   c. the evaporator and the drain heater will not heat
   d. all of the above

6. Why is a refrigerator using this diagram called a cycle defrost model?

   a. it defrosts when a timer switch closes
   b. it defrosts whenever the thermostat closes
   c. it defrosts whenever the thermostat opens

7. The coil in the relay is in series with the run winding. The amperage draw of the run winding operates the relay.

   a. True
   b. False

8. To make an ohmmeter reading of the stile heater:

   a. one end of the heater must be disconnected
   b. both ends must be disconnected
   c. there is no need to disconnect either end

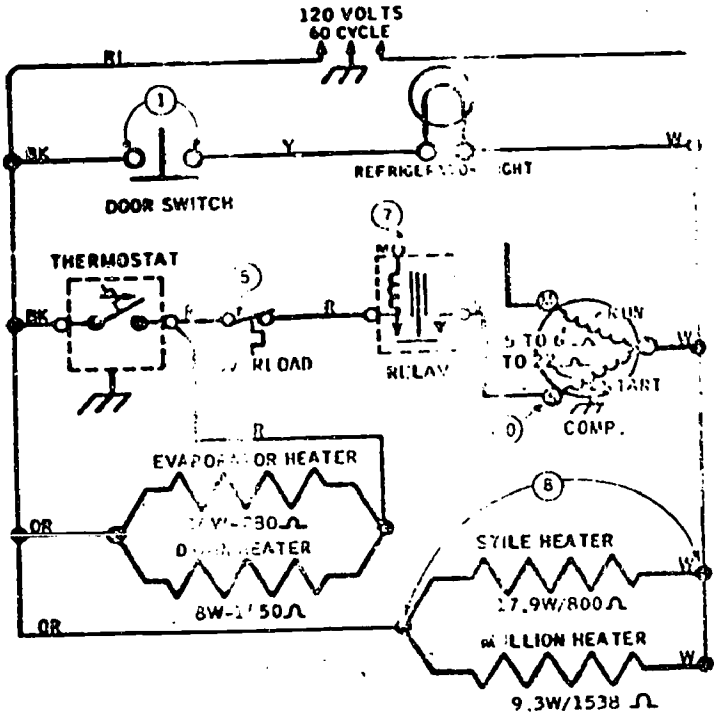
9. When the thermostat is manually turned to "off", the evaporator and the drain heaters will continue to heat as long as the refrigerator is plugged in.

   a. True
   b. False

10. There is a potential voltage at the compressor terminal "S" after the motor is up to speed and the relay contacts have opened.

   a. True
   b. False

The diagram below refers to question #1 of this LAP Test:



LAP TEST ANSWER KEY: REFRIGERATOR WIRING DIAGRAM

1. A,B
2. A
3. B
4. C
5. D
6. C
7. A
8. A
9. A
10. A

Student: _____ File Code: 761.01.01.15

Date: _____ Date Published: 5-25-79

Family Education Program

LAP TEST: DEFROST CIRCUITS

1. The voltage reading at #1 across the terminals of the defrost-bimetal should read:

   a. 120
   b. 0
   c. 24

2. The voltage at the defrost heater at #2 should read:

   a. 0
   b. 120
   c. 24

3. An ohm reading between "M" and "S" of this compressor should be between 7.5 and 28 ohms.

   a. True
   b. False

4. The voltage potential at #4 is:

   a. 0 volts
   b. 120 volts

5. The voltage potential at #5 is:

   a. 0 volts
   b. 120 volts

6. During the freezing cycles, the timer contacts from 1 to 4 will be made. The timer motor will run continuously.

   a. True
   b. False

7. The across-the-line circuits in this diagram are: (See diagram on page 2)

   a. the defrost bimetal and the heater
   b. the timer motor and lights
   c. the drain heater

8. An example of a series circuit would be the:

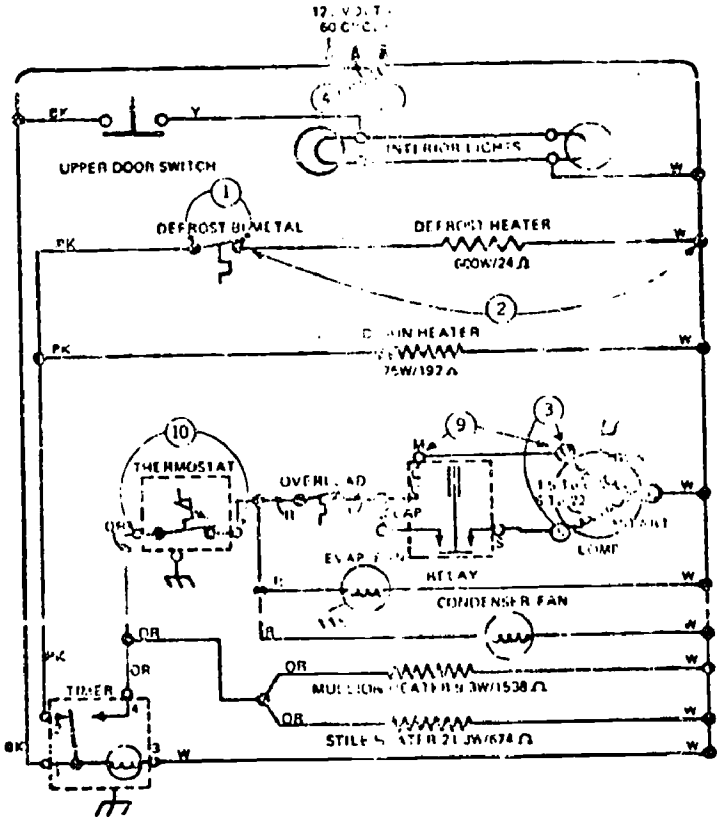
   a. defrost heater and bimetal
   b. mullion and stile heaters

9. If the line between "M" on the relay and "M" on the compressor is broken, the start winding will overheat.

   a. True
   b. False

10. If a jumper wire is attached at #10, the compressor and fans will run continuously except during the timer defrost periods.

   a. True
   b. False



LAP TEST ANSWER KEY: DEFROST CIRCUITS

1. B
2. B
3. A
4. B
5. A
6. A
7. B
8. A
9. B
10. A