Portfolio/ Assessment Package

AC/DC ELECTRICAL SYSTEMS

AMATROL®

CB227-BC00UEN

FIRST EDITION, REV. G

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INTRODUCTION

ABOUT THIS PACKAGE

This Portfolio/Assessment Package is written for the T7017 AC/DC Electrical Learning System.

Its purpose is to provide you with the materials necessary to assess the students' skills as they progress through the self-directed Learning Activity Packets in the learning system. It also contains the materials for documenting this accomplishment by building a portfolio of their work.

This introduction will give you an overview of the learning system, the other parts of this package, and how to use the learning system in your courses.

OVERVIEW OF AC/DC ELECTRICAL LEARNING SYSTEM

The AC/DC Electrical Learning System includes a complete set of industrial-quality lab hardware, written text, and laboratory activities that will teach students the fundamentals of electricity. These fundamentals include Ohm's Law, voltage, current and resistance measurements, series and parallel circuits, inductance, capacitance, and transformers.

This learning system is set up in a self-directed format where students can proceed at their own pace. The directions are provided in a series of six Learning Activity Packets (LAPs), listed below, which include text and lab activity directions.

LAP 1 Basic Electrical Circuits
LAP 2 Electrical Measurements
LAP 3 Circuit Analysis
LAP 4 Inductance and Capacitance
LAP 5 Combination Circuits
LAP 6 Transformers

This learning system can be used as a stand-alone teaching learning system within any class to give hands-on experience in electrical systems.

OVERVIEW OF LAP DESIGN

Each learning activity packet is approximately 30-70 pages in length and provides between 2 and 4 hours of learning.

Each packet is further divided into segments so the students will stop and review on a frequent basis. Questions are provided in a Self Review placed at the end of each segment so that students will be able to check their progress. Research has shown that student retention increases by 50% if they stop and review every 30 minutes.

Each segment contains all the information the student will need in order to complete the course. The knowledge or text information is given by sections titled "Objectives." The activities used to develop skills are, as you might expect, titled "Skills."

Because this material is self-directed, a great deal of research has gone into the design to make it motivating for students. This curriculum uses five important concepts:

- Just-in-time Presentation
- Learn-as-you-do
- Integrated skills
- Frequent mode changes
- Documented rapid accomplishment

The just-in-time presentation means only the material that the students absolutely need is provided in the Objective section. The students are presented with material that they can immediately apply. This helps them see why it is important, reduces the amount of reading, and helps their retention.

The just-in-time concept is taken a step further in this material by moving as much of the knowledge acquisition into the hands-on activities as possible. This is called learn-as-you-do. Our research has shown that students are much more motivated by learning while they are active. Also, this is the ultimate approach to immediate application of material.

The activities in each LAP are designed so that students will continue to reuse skills they have learned in earlier LAPs.

By having the students continue to reuse these skills in various learning systems, they will better understand how everything fits together. The constant re-enforcement of these skills, without the boring repetition of using them exactly the same way every time, will increase the students' retention of these skills. This technique allows us to teach skills in a shorter amount of time than it would normally take.

Another technique used in this material is to make sure that the students change mode on a frequent basis to avoid becoming bored. To accomplish this, the reading sequences are kept as short as possible and before there are hands-on activities so the students are frequently doing something different. Our research shows that students will stay on task much longer if they are involved in an active process such as working with a trainer.

Another key design feature of this curriculum is that it will give the students a feeling of rapid accomplishment. Part of this is done by dividing the course into LAPs and further into segments so that students "jump many smaller hurdles" rather than just a few large ones.

Another part is done by placing the titles of the objectives and skills at the point of presentation so the students always know what they are accomplishing and see that they are making progress almost page by page.

Allowing students to measure their progress and see that they are accomplishing something every day will be highly motivational.

LEARNING SYSTEM INSTALLATION

The AC/DC Electrical Learning System can be set up and inventoried using the Installation Guide included with the learning system. This manual gives a complete list and photos of the components included with the learning system. It also provides the layout and checkout instructions for the software and hardware.

PART I. STUDENT PORTFOLIO KIT MATERIALS

Part I of this package includes the sheets the students will use to build their portfolio. This consists of two sections: LAP Data Sheets and Skill Accomplishment Record Sheets.

The LAP Data Sheets, if available for this learning system, include all of the "blanks" from the LAPs themselves so your students will not have to write in them. This will allow you to reuse the LAPs from class to class.

The Skill Accomplishment Record sheets are also for the students to use. These sheets list the skills obtained from each LAP and provide spaces for you, the teacher, to sign off when the students have mastered each skill. The method used to verify the students' mastery of these skills will be covered later.

A copy of both of these sections should be made for each student before class and given to them. You have permission from Amatrol to do this. As an alternative, Amatrol publishes a student kit with these pages preprinted.

Each student will start their portfolio with a binder in which they will include these sheets. As they progress through the LAPs, they will be adding more materials (at the direction of the LAPs) to their portfolio. This might include drawings, diagrams, or computer printouts.

PART II. LAP ANSWERS AND SOLUTIONS

This part of this package includes two sections: Data Solutions and Self Review Answers.

The Data Solutions are the answers or sample data for the hands-on activities the student will be doing in the their LAPs. You should make these available to the student while they are going through the LAP activities so they can check their answers as they go.

You might want to make a copy of this section and keep it as a handout to the students. Since the material is self-directed, it is best that the students can check their answers immediately during the activity.

The Self Review Answers in the second section can be used in two ways. One way is to give them to the students ahead of time since this also is not part of their evaluation.

Another way is to hold these and evaluate the students' Self Reviews as a way of making sure they don't rush through the material. You might, as an example, require them to achieve an 80% on the Self Review before they can proceed to the next segment.

PART III. COGNITIVE ASSESSMENT

In addition to evaluating the students' skills, quizzes are also provided that evaluate the students' knowledge that supports this ability to perform these skills.

A quiz is provided in this part for each LAP with at least one question that covers each objective contained in the LAPs.

These quizzes can be used in addition to the Skill Assessment to determine the students' grades. Even if you don't use them for a grade, the quizzes should still be used as an indication of where the students may have problems (e.g. is it the hands-on skill or is it basic information relating to the skill where the problem is occurring).

PART IV. AUTHENTIC ASSESSMENT

Authentic assessments are used to determine if a student has mastered a skill by actually having them demonstrate that skill to you, the teacher, in a realistic setting. Authentic assessment is the only way to really know if students can do what their records say they can do.

This part of the package includes the necessary materials to perform authentic assessment of the skills in this learning system.

The two sections in this part are Skill Accomplishment Teacher's Guide and Skill Accomplishment Test. The Skill Accomplishment Teacher's Guide gives detailed directions to allow you to have the students demonstrate their skills. The skills evaluated are the same ones listed in Part 1, Section 2 of this package.

You will notice that some of these skills are covered at the same time and not always in numerical order. This is to make the evaluation as efficient as possible.

The other section of this part contains tests used for evaluating some of the skills. A skill such as "calculate the area of a circle" would normally have a test problem provided. The student would be given this test after they complete the LAP. This test would show whether or not the student has mastered this skill.

Most of the other skills are live demonstrations. This means that you, the teacher, will have the student go to the trainer and actually demonstrate the skill in your presence. An example might be to set the pressure on a hydraulic relief valve.

The assessment of the skills for each LAP can be done at anytime after the student has completed the LAP and feels confident that they have mastered the skills in that LAP.

The Skill Accomplishment Record Sheets will inform the student of the method in which their skills will be assessed, whether by test problems, live demonstration, or other means. These allow the student to be better prepared for the authentic assessment.

Because the materials are self-directed, you should have time available to conduct this evaluation of each student.

PART I

STUDENT PORTFOLIO KIT MATERIALS

1. LAP Data Sheets
2. Skill Accomplishment Record Sheets

LAP DATA SHEETS

1

There are no printed Data Sheets for the LAPs in this learning system. Have the students use their notebooks for collecting the data.

SKILL ACCOMPLISHMENT RECORD SHEETS

2

LAP 1: Basic Electrical Circuits
LAP 2: Electrical Measurements
LAP 3: Circuit Analysis
LAP 4: Inductance and Capacitance
LAP 5: Combination Circuits
LAP 6: Transformers

LAP 1: BASIC ELECTRICAL CIRCUITS

Student Name:_____ Date:_____

SKILL NO.	SKILL TITLE	SKILL RATING	DATE	TEACHER'S INITIAL
1	Use an AC tester to check a wall outlet for electricity			
2	Connect and operate a power supply			
3	Connect and operate a circuit using three types of manual switches			
4	Connect and operate an electrical circuit with a resistor			
5	Connect and operate an electrical circuit with a buzzer			
6	Connect and operate an electrical circuit with a solenoid			
7	Connect and operate an electrical circuit with a motor			

Evaluation Rubric

4..... Mastered Skill - Completed skill with no assistance in a timely manner.
3..... Not Mastered, Can Perform Skill Given Time - Completed skill with no assistance, but excessive time was required.
2..... Not Mastered, Can Perform Skill with Assistance - Completed skill with some assistance.
1..... Not Mastered, Can Only Perform Minimal Portions of Skill
0..... Not Mastered, Cannot Perform Skill

LAP 2: ELECTRICAL MEASUREMENTS

Student Name:_____ Date:_____

SKILL NO.	SKILL TITLE	SKILL RATING	DATE	TEACHER'S INITIAL
1	Use an analog voltmeter to measure the voltage at a point referenced to ground			
2	Use a DMM to measure the voltage of a point referenced to ground			
3	Use a DMM to measure voltage drops in series and parallel circuits			
4	Use a DMM to measure the electrical current			
5	Use a DMM to measure current in series and parallel circuits			
6	Use a DMM to measure the resistance of a component			
7	Measure the resistance in series and parallel circuits			
8	Test the continuity of wires using a DMM			

Evaluation Rubric

4.....Mastered Skill - Completed skill with no assistance in a timely manner.
3.....Not Mastered, Can Perform Skill Given Time - Completed skill with no assistance, but excessive time was required.
2.....Not Mastered, Can Perform Skill with Assistance - Completed skill with some assistance.
1.....Not Mastered, Can Only Perform Minimal Portions of Skill
0.....Not Mastered, Cannot Perform Skill

LAP 3: CIRCUIT ANALYSIS

Student Name:_____ Date:_____

SKILL NO.	SKILL TITLE	SKILL RATING	DATE	TEACHER'S INITIAL
1	Calculate series resistance given each load's resistance			
2	Use Ohm's Law to calculate voltage, current, and resistance in a series circuit			
3	Calculate the total power used by a series circuit			
4	Calculate the main line current in a parallel circuit			
5	Calculate the total parallel resistance			
6	Calculate the total power used in a parallel circuit			
7	Operate a circuit using a fuse			
8	Test and replace a fuse			
9	Operate a circuit using a circuit breaker			
10	Test and reset a circuit breaker			

Evaluation Rubric

4..... Mastered Skill - Completed skill with no assistance in a timely manner.
3..... Not Mastered, Can Perform Skill Given Time - Completed skill with no assistance, but excessive time was required.
2..... Not Mastered, Can Perform Skill with Assistance - Completed skill with some assistance.
1..... Not Mastered, Can Only Perform Minimal Portions of Skill
0..... Not Mastered, Cannot Perform Skill

LAP 4: INDUCTANCE AND CAPACITANCE

Student Name:_____ Date:_____

SKILL NO.	SKILL TITLE	SKILL RATING	DATE	TEACHER'S INITIAL
1	Connect and operate a relay in a circuit			
2	Calculate the total load on an AC circuit with inductors			
3	Discharge a capacitor			
4	Test a capacitor with a DMM			
5	Measure the voltage across a charged capacitor			
6	Calculate the total load on an AC circuit with capacitors			
7	Calculate the time to charge and discharge a capacitor			

Evaluation Rubric

4..... Mastered Skill - Completed skill with no assistance in a timely manner.
3..... Not Mastered, Can Perform Skill Given Time - Completed skill with no assistance, but excessive time was required.
2..... Not Mastered, Can Perform Skill with Assistance - Completed skill with some assistance.
1..... Not Mastered, Can Only Perform Minimal Portions of Skill
0..... Not Mastered, Cannot Perform Skill

LAP 5: COMBINATION CIRCUITS

Student Name:_____ Date:_____

SKILL NO.	SKILL TITLE	SKILL RATING	DATE	TEACHER'S INITIAL
1	Trace the current path in a combination circuit			
2	Solve a combination circuit			
3	Connect and operate a basic lighting circuit			
4	Connect and operate a ceiling fan circuit			
5	Connect and operate a rheostat as a lighter dimmer			
6	Design a voltage divider network			
7	Connect and operate a voltage divider network			
8	Locate a short circuit			
9	Locate an open circuit			

Evaluation Rubric

4..... Mastered Skill - Completed skill with no assistance in a timely manner.
3..... Not Mastered, Can Perform Skill Given Time - Completed skill with no assistance, but excessive time was required.
2..... Not Mastered, Can Perform Skill with Assistance - Completed skill with some assistance.
1..... Not Mastered, Can Only Perform Minimal Portions of Skill
0..... Not Mastered, Cannot Perform Skill

LAP 6: TRANSFORMERS

Student Name:_____ Date:_____

SKILL NO.	SKILL TITLE	SKILL RATING	DATE	TEACHER'S INITIAL
1	Connect and operate a transformer			
2	Calculate the secondary coil voltage of a transformer			
3	Troubleshoot a transformer by measuring continuity			
4	Size a transformer			
5	Calculate the current load on a transformer			
6	Design a control transformer circuit to provide a given line voltage			

Evaluation Rubric

4.....Mastered Skill - Completed skill with no assistance in a timely manner.
3.....Not Mastered, Can Perform Skill Given Time - Completed skill with no assistance, but excessive time was required.
2.....Not Mastered, Can Perform Skill with Assistance - Completed skill with some assistance.
1.....Not Mastered, Can Only Perform Minimal Portions of Skill
0.....Not Mastered, Cannot Perform Skill

PART II

LAP ANSWERS AND SOLUTIONS

3. Data Solutions
4. Self Review Answers

DATA SOLUTIONS 3

LAP 2: Electrical Measurements
LAP 3: Circuit Analysis
LAP 4: Inductance and Capacitance
LAP 5: Combination Circuits
LAP 6: Transformers

SEGMENT 2: INTRODUCTION TO SERIES AND PARALLEL CIRCUITS

SKILL 3: USE A DMM TO MEASURE VOLTAGE DROPS IN SERIES AND PARALLEL CIRCUITS

7A. ≈12 VDC
≈10 VDC
C. ≈10 VDC
≈ 5 VDC
≈ 5 VDC
D. ≈ 5 VDC
≈ 0 VDC
≈ 5 VDC
12. ≈ 2 VAC
13. ≈12 VAC
≈10 VAC
≈ 2 VAC
14. ≈11 VAC
≈ 6 VAC
≈ 5 VAC
≈ 6 VAC
≈ 0 VAC
≈ 6 VAC

SEGMENT 4: RESISTANCE MEASUREMENT

SKILL 7: MEASURE THE RESISTANCE IN SERIES AND PARALLEL CIRCUITS

3. approximately 60 ohms

SEGMENT 2: POWER IN PARALLEL CIRCUITS

SKILL 6: CALCULATE THE TOTAL POWER USED IN A PARALLEL CIRCUIT

6. Maximum output power = 120 × 20 = 2400 W
   Maximum # of 100 W bulbs = 2400/100 = 24

SEGMENT 2: INDUCTANCE

Activity 4: Effect of Inductive Reactance in an AC Circuit

9. ≈ 3.0 mA
   ≈ 28 VAC
   ≈ 900 ohms
   2.8-3.0 henrys @ 50 Hz
   2.3-2.5 henrys @ 60 Hz

NOTE

These values will vary widely because the transformer is not manufactured with closely held inductance values. Above numbers are typical.

SKILL 2: CALCULATE THE TOTAL LOAD ON AN AC CIRCUIT WITH INDUCTORS

4. 77.7 henrys @ 50 Hz
   65.1 henrys @ 60 Hz
   24,998 ohms @ 50 Hz
   24,507 ohms @ 60 Hz
6. 1.14 mA
7. 1.14 mA

NOTE

Values above will vary depending on the transformer. However, the values in steps 6 and 7 should be close. All values shown are typical.

12. 3.53 henrys @ 50 Hz
    2.95 henrys @ 60 Hz
    1108 ohms @ 50 Hz
    1112 ohms @ 60 Hz
14. 25 mA @ 50 Hz
    25 mA @ 60 Hz
15. 25 mA

NOTE

Values above will vary depending on the transformer. However, the values in steps 14 and 15 should be close. All values shown are typical.

SKILL 6: CALCULATE THE TOTAL LOAD ON AN AC CIRCUIT WITH CAPACITORS

4. 50µF @ 50 Hz
   55.6µF @ 60 Hz
   63.7 ohms @ 50 Hz
   47.7 ohms @ 60 Hz
6. 0.416 Amps @ 50 Hz
   0.560 Amps @ 60 Hz
7. 0.4-0.5 Amps @ 50 Hz
   0.5-0.6 Amps @ 60 Hz

NOTE

Values above will vary depending on the capacitors. However, the values in steps 6 and 7 should be close. All values shown are typical.

12. 100µF @ 50 Hz
    111.2µF @ 60 Hz
    31.8 Ohms @ 50 Hz
    23.85 Ohms @ 60 Hz
14. 0.83 Amps @ 50 Hz
    1.11 Amps @ 60 Hz
15. 0.8-0.9 Amps @ 50 Hz
    1.1-1.2 Amps @ 60 Hz

NOTE

Values above will vary depending on the capacitors. However, the values in steps 14 and 15 should be close. All values shown are typical.

SEGMENT 1: CHARACTERISTICS

SKILL 1: TRACE THE CURRENT PATH IN A COMBINATION CIRCUIT

3. Series
   Parallel
   Parallel
   Parallel
   Series
4. Parallel
   Parallel
   Series

SKILL 2: SOLVE A COMPLEX CIRCUIT

3. R_{EQ1} = 5 ohms
   R_{EQ2} = 20 ohms
   R_T = 85 ohms
   I_T = 0.14A
   V_{EQ1} = 0.7V
   V_{EQ2} = 2.8V
   V_{R5} = 7V
   V_{R6} = 1.4V
   I_{R1} = 0.07A
   I_{R2} = 0.07A
   I_{R3} = 0.112A
   I_{R4} = 0.028A

SEGMENT 4: TROUBLESHOOTING

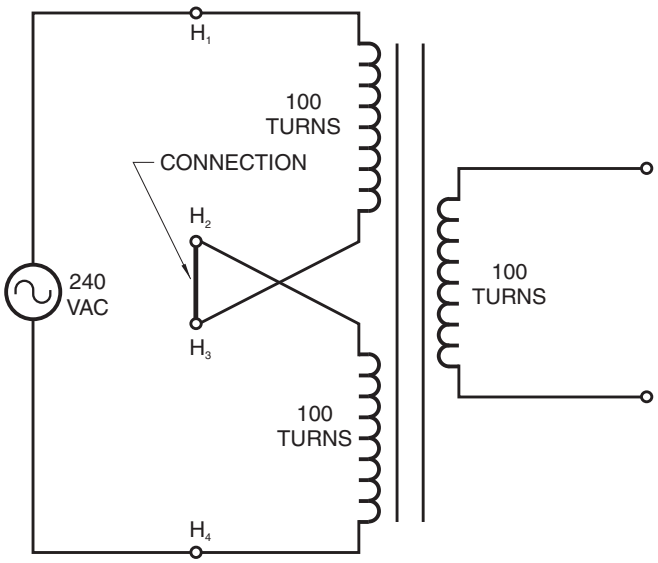
SKILL 9: LOCATE AN OPEN CIRCUIT

2C. 25 ohms

SEGMENT 3: TRANSFORMER TYPES

SKILL 6: DESIGN A CONTROL TRANSFORMER TO PROVIDE A GIVEN OUTPUT VOLTAGE

1.



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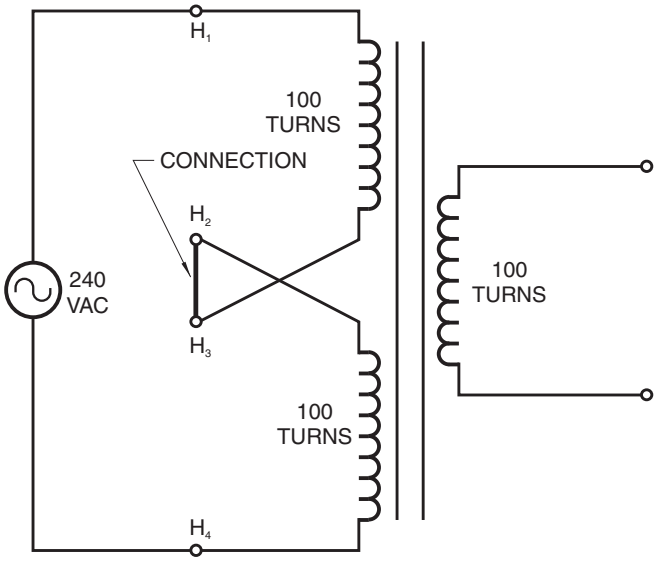

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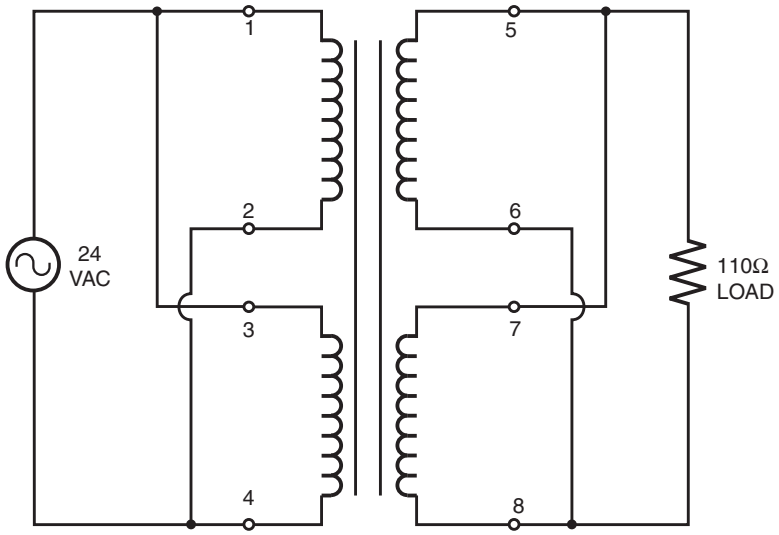


SELF REVIEW ANSWERS

4

LAP 1: BASIC ELECTRICAL CIRCUITS

SEGMENT 1

1. electricity (Objective 1)
2. current (Objective 1)
3. power supply (Objective 2)
4. direct (Objective 2)
5. battery (Objective 2)
6. alternating (Objective 2)
7. AC (Objective 2)
8. circuit tester (Objective 3)

SEGMENT 2

1. switch (Objective 4)
2. load (Objective 4)
3. conductor (Objective 4)
4. schematic (Objective 6)
5. voltage (Objective 5)
6. chemical (Objective 5)

SEGMENT 3

1. switch (Objective 7)
2. operator (Objective 7)
3. automatic (Objective 9)
4. open (Objective 7)
5. spring (Activity 3)

SEGMENT 4

1. lamp (Objective 11)
2. solenoid (Objective 11)
3. heat (Skill 4)
4. sound (Objective 11)
5. rotary (Objective 11)

LAP 2: ELECTRICAL MEASUREMENTS

SEGMENT 1

1. Voltage (Objective 1)
2. volts (Objective 1)
3. V (Objective 1)
4. digital multimeter, DMM (Objective 4)
5. lower (Skill 2)
6. voltage (Objective 4)
7. ground (Objective 3)

SEGMENT 2

1. series (Objective 5)
2. parallel (Objective 5)
3. divided (Objective 6)
4. ground (Objective 6)
5. branch (Objective 6)
6. parallel (Activity 2)

SEGMENT 3

1. amperes (Objective 7)
2. A (Objective 7)
3. series (Objective 9)
4. series (Objective 10)
5. parallel (Objective 10)

SEGMENT 4

1. ohms (Objective 11)
2. Ω (Objective 11)
3. continuity (Objective 15)
4. power source (Objective 15)
5. across (Objective 13)
6. disconnect (Objective 13)

LAP 3: CIRCUIT ANALYSIS

SEGMENT 1

1. Ohm's (Objective 2)
2. Kirchhoff's (Objective 3)
3. E = I × R (Objective 2)
4. current (Objective 5)
5. resistance (Objective 1)

SEGMENT 2

1. main line (Objective 6)
2. equal (Objective 6)
3. decreases (Objective 7)
4. increase (Objective 6)
5. sum (Objective 6)

SEGMENT 3

1. fuse (Objective 9)
2. blow (Objective 9)
3. continuity (Objective 9)
4. reset (Objective 10)
5. temperature (Objective 10)
6. surge (Objective 10)
7. circuit breaker (Objective 10)
8. short circuit (Objective 8)

LAP 4: INDUCTANCE AND CAPACITANCE

SEGMENT 1

1. magnetic field (Objective 1)
2. coil (Objective 1)
3. Electromagnetic (Objective 1)
4. solenoid (Objective 2)
5. vibration (Objective 2)
6. rotary (Objective 2)
7. relay (Objective 2)

SEGMENT 2

1. Inductance (Objective 3)
2. henrys (Objective 3)
3. five (Objective 6)
4. series (Objective 7)
5. ballast (Objective 6)
6. infinite (Objective 5)

SEGMENT 3

1. capacitor (Objective 9)
2. nonpolarized (Objective 11)
3. Electrolytic (Objective 11)
4. capacitance (Objective 9)
5. farads (Objective 9)
6. dielectric (Objective 10)
7. discharge (Objective 10)
8. shorted (Objective 10)

SEGMENT 4

1. source (Objective 12)
2. open (Objective 12)
3. dielectric (Objective 12)
4. reactance (Objective 13)
5. decreased (Objective 13)
6. increased (Objective 14)
7. capacitance (Objective 15)
8. increased (Objective 15)

SEGMENT 5

1. ballast (Objective 16)
2. capacitor (Objective 17)
3. time-delay (Objective17)
4. constant (Objective 18)
5. filtering (Objective 18)

LAP 5: COMBINATION CIRCUITS

SEGMENT 1

1. combination (Objective 1)
2. trace (Objective 2)
3. in parallel (Objective 2)
4. analyzing (Objective 2)
5. in series (Objective 1)
6. resistance (Objective 3)
7. split (Objective 2)
8. simplifying or solving (Objective 3)

SEGMENT 2

1. Switches (Objective 4)
2. ceiling fan (Objective 4)
3. variable (Objective 5)
4. rheostat (Objective 5)
5. potentiometer (Objective 5)
6. slider (Objective 5)
7. dim (Objective 5)

SEGMENT 3

1. voltage divider (Objective 6)
2. 10 (Objective 7)
3. bleeder (Objective 7)
4 different (Objective 6)
5. resistances (Objective 7)

SEGMENT 4

1. parallel (Objective 8)
2. main line (Objective 8)
3. open (Objective 8)
4. 3 (Objective 10)
5. increase (Objective 10)
6. shorted (Objective 8)
7. replacing (Objective 10)
8. circuit (Objective 10)

LAP 6: TRANSFORMERS

SEGMENT 1

1. Mutual inductance (Objective 2)
2. transformer (Objective 1)
3. primary (Objective 2)
4. secondary (Objective 2)
5. turns ratio (Objective 3)

SEGMENT 2

1. transformer (Objective 5)
2. Volt-Amperes (VA) (Objective 5)
3. loss (Objective 6)
4. efficiency (Objective 6)
5. primary (Objective 7)

SEGMENT 3

1. isolation (Objective 8)
2. center tap (Objective 10)
3. control (Objective 9)
4. distribution (Objective 10)
5. auto (Objective 8)

PART III

COGNITIVE ASSESSMENT

5. Quiz
6. Quiz Answers

QUIZ 5

LAP 1: Basic Electrical Circuits
LAP 2: Electrical Measurements
LAP 3: Circuit Analysis
LAP 4: Inductance and Capacitance
LAP 5: Combination Circuits
LAP 6: Transformers

LAP 1: BASIC ELECTRICAL CIRCUITS

Student Name:_____ Date:_____

Circle the Correct Answer

1. Electricity is the flow of _____ in a conductor.
   A. protons
   B. neutrons
   C. electrons
   D. photons

2. The electrical wall outlets at home are a source of _____ current.
   A. direct
   B. alternating
   C. both direct and alternating
   D. None of the above

3. Alternating current is one type of electrical current, what is the other type?
   A. In-rush current
   B. River current
   C. Direct current
   D. Unaltered current

4. Constant voltage power supplies will maintain a constant voltage output under varying _____.
   A. loads
   B. weather conditions
   C. levels of light
   D. chemical reactions

5. Which of the following is not a component of a basic electrical circuit?
   A. Input device
   B. Output device
   C. Insulator
   D. Power supply

6. A simple method for opening or closing a circuit is to use a _____.
   A. switch
   B. knife
   C. screwdriver
   D. None of the above

7. Which of the following is true of an electrical schematic diagram?
   A. Represents components with standard symbols.
   B. Shows how the components are interconnected.
   C. Is helpful in troubleshooting a circuit.
   D. All of the above

8. Which of the following is a manually-operated switch?
   A. Pushbutton switch
   B. Selector switch
   C. Knife switch
   D. All of the above

9. The contacts of a(n) _____ switch are open until acted on by the operator.
   A. normally closed
   B. adjacent
   C. normally open
   D. normally simulated

10. Which of the following is an electrical output device?
    A. Motor
    B. Lamp
    C. Resistor
    D. All of the above

11. Rotary motion is the output of which electrical output device?
    A. Buzzer
    B. Resistor
    C. Motor
    D. Solenoid

LAP 1: BASIC ELECTRICAL CIRCUITS

Student Name:_____ Date:_____

12. A knife switch consists of a lever and one or more sets of _____.
    A. conductors
    B. operators
    C. knives
    D. contacts

13. A(n) _____ determines if electricity is present in a circuit.
    A. ohmmeter
    B. circuit tester
    C. ammeter
    D. solenoid

LAP 2: ELECTRICAL MEASUREMENTS

Student Name:_____ Date:_____

Circle the Correct Answer

1. The potential difference between two points in a circuit is called _____.
   A. current
   B. voltage
   C. resistance
   D. None of the above

2. The units of measurement for voltage is the _____.
   A. ohm
   B. amp
   C. watt
   D. volt

3. A known reference point in an electrical circuit is called a _____.
   A. common
   B. zero reference
   C. negative
   D. positive

4. A(n) _____ is a measurement device used to measure voltage.
   A. ohmmeter
   B. multimeter
   C. voltmeter
   D. ammeter

5. A multimeter is a multipurpose device that can measure _____.
   A. voltage and resistance
   B. voltage and current
   C. resistance and current
   D. voltage, current, and resistance

6. The amount of voltage that is used by each load depends on the _____ of each load.
   A. drop
   B. continuity
   C. amps
   D. resistance

7. An ammeter is used to measure _____.
   A. current
   B. resistance
   C. voltage
   D. temperature

8. Resistance is measured in units of _____.
   A. volts
   B. watts
   C. ohms
   D. amps

9. If a wire has continuity, it _____.
   A. cannot conduct current
   B. will have almost no resistance
   C. cannot be used in a circuit
   D. has an open

10. A _____ circuit is one in which there is only one path for current to travel.
    A. complex
    B. series
    C. parallel
    D. closed

11. In a(n) _____ circuit, the voltage available to each branch is equal to the source voltage.
    A. parallel
    B. series
    C. short
    D. open

12. Current is measured in units of _____.
    A. amps
    B. volts
    C. ohms
    D. Pascals

LAP 2: ELECTRICAL MEASUREMENTS

Student Name:_____ Date:_____

13. To measure current through a component, the ammeter must be connected _____ the component.
    A. across
    B. in parallel with
    C. in series with
    D. without

14. Current in a(n) _____ circuit is divided among the branches of the circuit.
    A. series
    B. parallel
    C. open
    D. short

15. A(n) _____ is used to measure resistance.
    A. ohmmeter
    B. ammeter
    C. voltmeter
    D. flowmeter

16. Which of the following statements is not true about measuring the resistance of a component that is connected in a circuit?
    A. Turn off the power supply.
    B. Disconnect one of the component leads from the circuit.
    C. Make sure the power supply is on.
    D. Connect the leads across the component.

17. When leads are connected in series, their individual resistances are _____.
    A. multiplied
    B. divided
    C. subtracted
    D. added

LAP 3: CIRCUIT ANALYSIS

Student Name:_____ Date:_____

Circle the Correct Answer

1. To find the total resistance in a series circuit, _____.
   A. multiply the individual resistances
   B. average the resistances
   C. add the individual resistances
   D. subtract the individual resistances

2. Which is not an application of Ohm's Law?
   A. Troubleshooting circuits
   B. Sizing components
   C. Creating multiple voltage levels
   D. All of the above
   E. None of the above

3. The Ohm's Law formula for calculating voltage is _____.
   A. $E = I \times R$
   B. $E = P \times R$
   C. $E = P \times I \times R$
   D. All of the above
   E. None of the above

4. Kirchhoff's Voltage Law for a series circuit says that the total voltage is equal to _____.
   A. the smallest voltage drop
   B. the sum of the voltage drops
   C. the product of the voltage drops
   D. the largest voltage drop

5. The measure of energy consumed by a circuit is called _____.
   A. usage
   B. power
   C. dissipation
   D. consumption

6. Which of the following is a formula for calculating power?
   A. $P = I \times E$
   B. $P = I \times R$
   C. $P = E / R$
   D. All of the above
   E. None of the above

7. The current that flows from and back to the power supply in a parallel circuit is called _____ current.
   A. maximum
   B. main line
   C. Kirchhoff's
   D. minimum

8. Which of the following is a formula for calculating total resistance in a parallel circuit?
   A. $R_T = E_T \times I_T$
   B. $R_T = R_1 + R_2 + R_3$
   C. $R_T = \dfrac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$
   D. All of the above
   E. None of the above

9. Which of the following is a type of circuit protection device?
   A. Fuse
   B. Resistor
   C. Rheostat
   D. Capacitor

10. When the wire or foil strip inside a fuse melts, the fuse is said to be _____.
    A. shot
    B. done
    C. blown
    D. tripped

11. The difference between a fuse and a circuit breaker is _____.
    A. circuit breakers are cheaper
    B. circuit breakers can be reset and used again
    C. fuses are re-usable
    D. All of the above
    E. None of the above

LAP 4: INDUCTANCE AND CAPACITANCE

Student Name:_____ Date:_____

Circle the Correct Answer

1. The concept of a magnetic field being formed around a conductor when current flows through it is called _____.
   A. capacitance
   B. electromagnetism
   C. flux
   D. All of the above
   E. None of the above

2. Which of the following is not an example of an electromagnetic device?
   A. Solenoid
   B. Relay
   C. Resistor
   D. Motor

3. Inductance is measured in _____.
   A. ohms
   B. farads
   C. henrys
   D. rpms

4. A coil that opposes any change in current flow is called a(n) _____.
   A. inductor
   B. capacitor
   C. transducer
   D. oscillator

5. The resistance provided by an inductor in an AC circuit is called _____.
   A. induced resistance
   B. inductive reactance
   C. electromotive force
   D. All of the above
   E. None of the above

6. Which of the following is the correct formula for calculating total series inductance?
   A. $L_T = L_1 + L_2 + L_3 \ldots$
   B. $L_T = L_1 \times L_2 \times L_3 \ldots$
   C. $L_T = 1/L_1 + 1/L_2 + 1/L_3 \ldots$
   D. All of the above
   E. None of the above

7. A common inductor found in fluorescent light fixtures is a _____.
   A. starter
   B. cathode
   C. ballast
   D. switcher

8. Which of the following is the correct formula for calculating total parallel inductive reactance in a parallel circuit?
   A. $X_{LT} = X_{L1} + X_{L2} + X_{L3} \ldots$
   B. $X_{LT} = X_{L1} \times X_{L2} \times X_{L3} \ldots$
   C. $X_{LT} = \dfrac{1}{\dfrac{1}{X_{L1}} + \dfrac{1}{X_{L2}} + \dfrac{1}{X_{L3}}} \ldots$
   D. $X_{LT} = \dfrac{1}{X_{L1}} + \dfrac{1}{X_{L2}} + \dfrac{1}{X_{L3}} \ldots$

9. The energy stored by a capacitor is called a(n) _____.
   A. induced voltage
   B. electrostatic charge
   C. voltage spike
   D. All of the above
   E. None of the above

10. Which of the following is a type of capacitor?
    A. Electrolytic
    B. Nonpolarized
    C. Variable
    D. All of the above
    E. None of the above

11. Capacitance is measured in _____.
    A. farads
    B. henrys
    C. ohms
    D. volts

LAP 4: INDUCTANCE AND CAPACITANCE

Student Name:_____ Date:_____

12. One of the effects a capacitor has in a DC circuit is that it will _____.
    A. charge to a voltage equal to the source voltage
    B. continue to charge until the source is completely drained
    C. act like an open until it is fully charged
    D. All of the above
    E. None of the above

13. The apparent resistance to AC by a capacitor is called _____.
    A. frequency displacement
    B. capacitive reactance
    C. passive capacitance
    D. filtering

14. Which of the following is the total series capacitive reactance formula?
    A. $X_{CT} = X_{C1} \times X_{C2} \times X_{C3}...$
    B. $X_{CT} = X_{C1} - X_{C2} - X_{C3}...$
    C. $X_{CT} = X_{C1} + X_{C2} + X_{C3}...$
    D. $X_{CT} = \dfrac{1}{\dfrac{1}{X_{C1}} + \dfrac{1}{X_{C2}} + \dfrac{1}{X_{C3}}}...$

15. A time-delay relay that uses an RC timing circuit is called a(n) _____.
    A. solid-state, time-delay relay
    B. adjustable relay
    C. dashpot time-delay relay
    D. motor-driven, time-delay relay

16. In an electric DC power supply, a capacitor is commonly used to _____.
    A. block the current flow
    B. increase the current flow
    C. filter out the unwanted AC voltage
    D. decrease the voltage

17. The formula for calculating total parallel capacitance is _____.
    A. $C_T = C_1 + C_2 + C_3...$
    B. $\dfrac{1}{C_T} = \dfrac{1}{C_1} + \dfrac{1}{C_2} + \dfrac{1}{C_3}...$
    C. $C_T = C_1 \times C_2 \times C_3...$
    D. $C_T = C_1 - C_2 - C_3...$

18. _____ affects a DC circuit only when the current is first turned on, turned off, or when there is a charge in the load resistance.
    A. Capacitance
    B. Inductance
    C. A time delay
    D. A relay

LAP 5: COMBINATION CIRCUITS

Student Name:_____ Date:_____

Circle the Correct Answer

1. In a series-parallel circuit, components that are connected in parallel will display characteristics of a(n) _____.
   A. series circuit
   B. parallel circuit
   C. open circuit
   D. short circuit

2. In order to identify the series and parallel section of a combination circuit, _____.
   A. eliminate the parallel section
   B. use a DMM
   C. trace the current path
   D. All of the above
   E. None of the above

3. Which of the following is not one of the seven general steps for solving a combination circuit?
   A. Calculate the equivalent resistance for all parallel sections.
   B. Calculate the total resistance of the circuit.
   C. Calculate the total current.
   D. Calculate the RC time constant.

4. Which of the following is an application of a combination circuit?
   A. Commercial building's lighting
   B. Electrical outlets controlled by a switch
   C. Ceiling fan control
   D. All of the above
   E. None of the above

5. A circuit that uses resistors to produce a voltage that is lower than the source voltage is called a _____.
   A. step-down transformer
   B. reduction circuit
   C. voltage divider
   D. voltage converter

6. In order for a firm voltage divider to operate properly, the load resistance value should be at least _____ times greater than resistance value of the voltage divider resistor.
   A. 10
   B. 2
   C. 5
   D. 8

7. Which of the following is an application of a variable resistor?
   A. Radio volume controls
   B. Television controls
   C. Dim lighting
   D. All of the above
   E. None of the above

8. A variable resistor is different from a fixed resistor because it _____.
   A. doesn't have to be connected in a circuit to work
   B. can be adjusted
   C. can be used only in AC circuits
   D. All of the above
   E. None of the above

9. A short circuit in the branch of a parallel circuit will _____.
   A. cause an excessive amount of current to flow
   B. damage or destroy the power supply
   C. cause a short circuit across the power supply
   D. All of the above
   E. None of the above

LAP 5: COMBINATION CIRCUITS

Student Name:_____ Date:_____

10. Which of the following is not a step for trouble-shooting a parallel circuit to find a short?
    A. Disconnect the power supply.
    B. Look for visible signs of damage.
    C. Connect an ohmmeter across the main line.
    D. All of the above
    E. None of the above

11. What is the result when a branch of a parallel circuit has an open?
    A. It has no effect on the circuit.
    B. The circuit will not operate.
    C. The rest of the circuit will operate with a reduced current.
    D. It will cause a short to develop.

LAP 6: TRANSFORMERS

Student Name:_____ Date:_____

Circle the Correct Answer

1. A common application of mutual inductance is found in a device called a _____.
   A. buzzer
   B. motor
   C. relay
   D. transformer

2. Which of the following is not a component of a transformer?
   A. Plate
   B. Secondary
   C. Primary
   D. Core

3. In order to calculate the output voltage of a transformer, divide the input voltage by the _____.
   A. frequency
   B. turns ratio
   C. input current
   D. resistance

4. Which of the following is a method to troubleshoot a transformer?
   A. Measuring the current flow
   B. Measuring the weight of the transformer
   C. Measuring the continuity of the coils
   D. All of the above
   E. None of the above

5. The power relationship on a transformer states that _____.
   A. power in = power out + loss
   B. power in = 1/2 power out
   C. power in = 2 × power out
   D. All of the above
   E. None of the above

6. Transformers are usually rated in units called _____.
   A. amperes
   B. hertz
   C. volt amperes
   D. ohms

7. The current load of a transformer is the current drawn by the _____.
   A. load connected to the transformer
   B. secondary with no load connected
   C. load connected to the primary
   D. primary winding itself

8. Which type of transformer is commonly used to reduce line voltages of 240 VAC or 480 VAC to 120 VAC?
   A. Isolation transformer
   B. Control transformer
   C. Autotransformer
   D. Distribution transformer

9. A common application of a center tap on the secondary of a transformer is a(n) _____.
   A. autotransformer
   B. step-up transformer
   C. distribution transformer
   D. All of the above
   E. None of the above

10. Which of the categories of transformers uses only one coil for the primary and secondary?
    A. Distribution transformer
    B. Autotransformer
    C. Isolation transformer
    D. Control transformer

11. A _____ is an electrical device that converts AC electricity from one voltage level to another.
    A. transformer
    B. primary coil
    C. secondary coil
    D. center tap

QUIZ ANSWERS 6

LAP 1: BASIC ELECTRICAL CIRCUITS

1. C (Objective 1)
2. B (Objective 2)
3. C (Objective 2)
4. A (Objective 5)
5. C (Objective 4)
6. A (Objective 7)
7. D (Objective 6)
8. D (Objective 9)
9. C (Objective 8)
10. D (Objective 12)
11. C (Objective 11)
12. D (Objective 10)
13. B (Objective 3)

LAP 2: ELECTRICAL MEASUREMENTS

1. B (Objective 1)
2. D (Objective 1)
3. A (Objective 3)
4. C (Objective 2)
5. D (Objective 4)
6. D (Objective 6)
7. A (Objective 8)
8. C (Objective 11)
9. B (Objective 15)
10. B (Objective 5)
11. A (Objective 6)
12. A (Objective 7)
13. C (Objective 9)
14. B (Objective 10)
15. A (Objective 12)
16. C (Objective 13)
17. D (Objective 14)

LAP 3: CIRCUIT ANALYSIS

1. C (Objective 1)
2. E (Objective 2)
3. A (Objective 2)
4. B (Objective 3)
5. B (Objective 4)
6. A (Objective 5)
7. B (Objective 6)
8. C (Objective 7)
9. A (Objective 8)
10. C (Objective 9)
11. B (Objective 10)

LAP 4: INDUCTANCE AND CAPACITANCE

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

LAP 5: COMBINATION CIRCUITS

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

LAP 6: TRANSFORMERS

1. D (Objective 2)
2. A (Objective 2)
3. B (Objective 3)
4. C (Objective 4)
5. A (Objective 6)
6. C (Objective 5)
7. D (Objective 7)
8. B (Objective 9)
9. C (Objective 10)
10. B (Objective 8)
11. A (Objective 1)

PART IV

AUTHENTIC ASSESSMENT

7. Skill Accomplishment Teacher's Guide
8. Skill Accomplishment Test

SKILL ACCOMPLISHMENT TEACHER'S GUIDE

7

INTRODUCTION

The purpose of this section is to provide the instructor with the materials necessary to perform an authentic assessment of the students' skills on the hands-on portion of the learning system. Authentic assessments are used to determine if students have mastered a skill by actually having them demonstrate that skill for the instructor in a realistic setting.

There are two parts to the authentic assessment: Skill Accomplishment Teacher's Guide, contained in this section, and Skill Accomplishment Tests, contained in Section 8.

The Skill Accomplishment Teacher's Guide gives detailed directions to allow the instructor to have the students demonstrate their skills. You will notice that some of these skills are covered at the same time and not always in numerical order. The reason for this is to make the evaluation as time efficient at possible.

The Skill Accomplishment Tests are handouts that contain information needed by the students as they demonstrate their skills. The handouts may contain instructions, graphics, or other information to aid in the completion of the skill.

Most of the authentic assessments require a live demonstration. This means that you, the instructor, will have the student go to the equipment and have them demonstrate the skill in your presence.

The assessment of the skills for each module can be done at any time after the student has completed an individual module and feels confident that he or she has mastered the skills contained in that module. Because the curriculum is self-directed, you should have time available to conduct this evaluation of each student.

The students' mastery of the skills performed during the live demonstrations may be graded using the following evaluation rubric.

Give the student a point score for each skill on the following basis:

Evaluation Rubric

4..... Mastered Skill - Completed skill with no assistance in a timely manner.
3..... Not Mastered, Can Perform Skill Given Time - Completed skill with no assistance, but excessive time was required.
2..... Not Mastered, Can Perform Skill with Assistance - Completed skill with some assistance.
1..... Not Mastered, Can Only Perform Minimal Portions of Skill
0..... Not Mastered, Cannot Perform Skill

LAP 1: BASIC ELECTRICAL CIRCUITS

SKILL 1: Have the student demonstrate how to use the circuit tester to check the wall outlet.

SKILL 2-7: Have the student connect Test Circuit ES1-1-1. Make sure the student properly connects the circuit to the power supply and that the student selects the proper output (AC or DC) according to the schematic.

Have the student operate Test Circuit ES1-1-1 with the knife switch. You can also have them replace the knife switch with the other switches and replace the lamp in Test Circuit ES1-1-1 with a resistor, the buzzer, the solenoid, or the fan, and operate the circuit. Make sure they observe the polarity of the fan and the buzzer when they connect them.

SKILL 1-8: Have the student connect Test Circuit ES1-2-1 and measure the voltage referenced to ground of point 2 using the analog voltmeter and the DMM. Make sure the student has the DMM set properly.

Answer: Vpoint 2 = approximately 17.14 VDC

Next have the student measure the voltage drop across the 10 Ω resistor.

Answer V_{R1} = 6.86 VDC

Have the student measure the current in the circuit with the DMM. Make sure the student has the DMM on the proper setting and that the test leads are in the correct input terminals.

Have the student measure the resistance of R2 in the test circuit. Make sure the student turns off the power supply and disconnects one side of the load from the circuit.

Answer: R2 = 25 Ω

Have the student measure the continuity of one wire in the test circuit using the DMM. Have the student check the continuity using both methods (resistance and continuity tester).

SKILLS 1/2/3: Give the student Test Problem ES1-3-1 to solve.

Answers: RT = 103.1 Ω
I = 0.12 A
PT = 1.44 W

SKILLS 4/5/6: Give the student Test Problem ES1-3-2 to solve.

Answers: RT = 6.25 Ω
IT = 1.92 A
PT = 23.04 W

SKILLS 7/8: Have the student connect and operate Test Circuit ES1-3-3.

Ask the student why the fuse did not blow.

Answer: The main line current is below the current rating of the fuse.

Next, have the student demonstrate the method for replacing a fuse. The student should first make sure the power is off. Then, the student should use the fuse puller to pull up until one end of the fuse is completely free of the clip. Next, the student should pull the other end of the fuse out of the clip.

To replace the fuse, the student should use the fuse puller to place the fuse into the clip and then press down until the fuse "clicks" into place.

SKILLS 9/10: Have the student connect and operate Test Circuit ES1-3-4. Ask the student why the circuit breaker tripped.

Answer: Because the main line current exceeded the current rating of the circuit breaker.

Have the student demonstrate how to test the continuity of the circuit breaker using a DMM and then reset the circuit breaker.

LAP 4: INDUCTANCE AND CAPACITANCE

SKILL 1: Have the student connect and operate test circuit ES1-4-1. Ask the student to explain why relays are often used in machines.

Answer: Because relay contacts can control large amounts of current with only a small amount of input current.

SKILL 2: Give the student problem ES1-4-2 to solve.

Answer: LT = 2.65H

X_{LT} = 833 ohms

SKILL 3: Have the student demonstrate how to safely discharge a capacitor using one of the capacitor modules and ask the student why it is important to discharge a capacitor.

Answer: It could deliver a bad shock.

SKILL 4: Have the student test both of the capacitors with the DMM and tell you whether each is good or bad. Also, have the student explain how they determined if they are good or bad.

Answer: The resistance reading should drop to a low resistance and then start climbing if the capacitor is good. If it is bad, the resistance will be close to zero and will not change, indicating that the dielectric is shorted.

SKILL 5: Have the student charge a capacitor and then measure the voltage across it with the DMM. Ask the student why the voltage starts dropping when the voltage is measured.

SKILL 6: Give the student problem ES1-4-3 to solve.

Answer: Total capacitance = 75µF.

SKILL 7: Give the student problem ES1-4-4 to solve.

Answer: Charge time = 1.25 ms

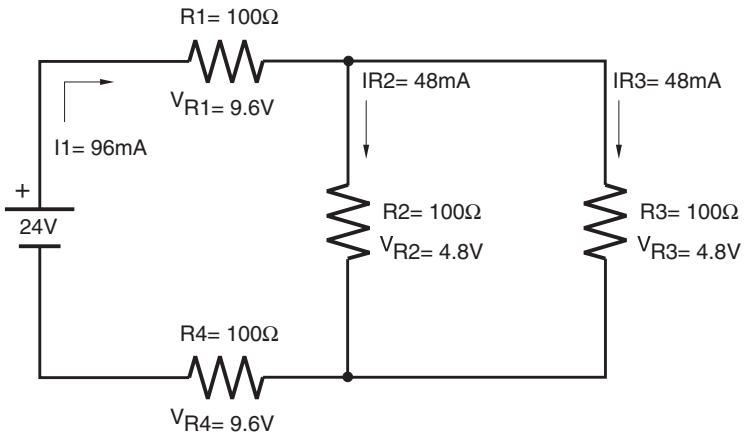
Discharge time = 1.25 s

SKILL 1: Give the student problem ES1-5-1 to solve.

Answer: R1 and R2 in series, R3||R4, R5||R6

SKILL 2: Give the student problem ES1-5-2 to solve.

Answer:



SKILL 3: Have the student connect and operate test circuit ES1-5-3.

Ask the student why Lamp 1 does not stay on like Lamp 2 when the switch is opened.

Answer: The switch is in series with Lamp 1. It does not affect Lamp 2. When the switch is opened, the current path to Lamp 1 is broken.

SKILL 4: Have the student connect test circuit ES1-5-4. Have the student turn on the fan and the lamps, then turn off the fan and leave the lamps on. Now have the student turn the fan on and turn the lamps off. Finally, have the student turn both the fan and the lamps off without turning off the main switch.

SKILL 5: Have the student connect and operate test circuit ES1-5-5. Ask the student to explain why the lamps dim as the rheostat resistance is increased.

Answer: More voltage is dropped across the rheostat, leaving less voltage to be dropped across the lamps.

SKILL 6: Give the student problem ES1-5-6 to solve.

Answer: R1 = 3.23 ohms

Answer: R2 = 30 ohms

SKILL 7: Have the student connect test circuit ES1-5-7. Ask the student what type of voltage divider it is.

Answer: Firm

LAP 5: COMBINATION CIRCUITS

SKILL 8: Give the student problem ES1-5-8 to solve.

Answer: R4 is shorted.

SKILL 9: Give the student problem ES1-5-9 to solve.

Answer: R2 is open.

LAP 6: TRANSFORMERS

SKILL 1/6: Give the student Test Circuit ES1-6-1 and have them connect it. Have the student measure the input and output voltages and tell you what the turns ratio is for this configuration.

Answer: 4:1

SKILL 2: Give the student Test Problem ES1-6-2 to solve.

Answer: 30 VAC

SKILL 3: Have the student measure each primary for an open. Ask the student how to tell if a coil has an open.

Answer: If the resistance is infinite, the coil has an open.

Have the student check between coils for a short. Ask the student how to tell if the transformer is good by doing this.

Answer: If the readings are anything other than infinite, the transformer is bad and should be replaced.

SKILL 4/5: Give the student Test Problem ES1-6-3 to solve.

Answer: Part 1. Max VA = 240 VA

VA of transformer chosen = 100 VA

Answer: Part 2. Primary Current (IP) of Chosen Transformers = $\frac{273}{240}$ = 1.14A

Total current draw on breaker = 15 + 1.4 = 16.14A

Overload the circuit breaker = No

SKILL ACCOMPLISHMENT TEST

8

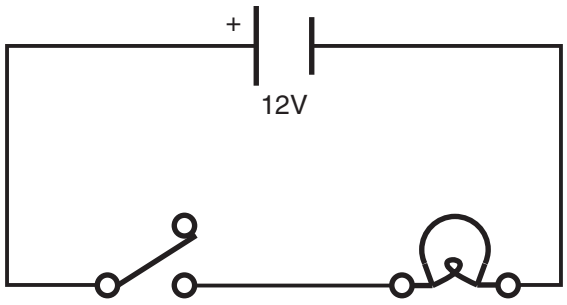
LAP 1: Basic Electrical Circuits
LAP 2: Electrical Measurements
LAP 3: Circuit Analysis
LAP 4: Inductance and Capacitance
LAP 5: Combination Circuits
LAP 6: Transformers

LAP 1: BASIC ELECTRICAL CIRCUITS

Student Name:_____ Date:_____

SKILL ACCOMPLISHMENT TEST CIRCUIT ES1-1-1

DIRECTIONS: Connect and operate the circuit shown in the following schematic diagram on the 7017 trainer. Make changes in the circuit as directed by your instructor.

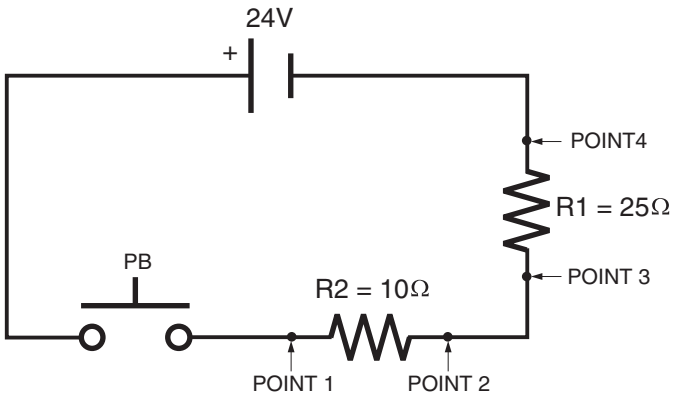


LAP 2: ELECTRICAL MEASUREMENT

Student Name:_____ Date:_____

SKILL ACCOMPLISHMENT TEST CIRCUIT ES1-2-1

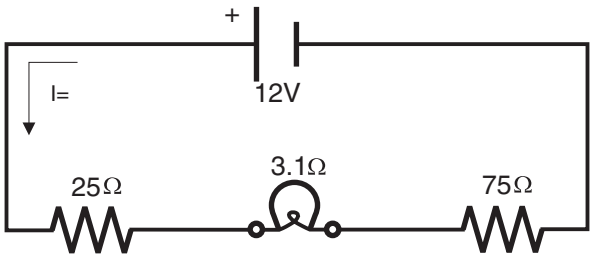
DIRECTIONS: Connect and operate the circuit shown in the following schematic diagram on the 7017 trainer. Make any measurements or changes that your instructor directs.



Student Name:_____ Date:_____

TEST PROBLEM ES1-3-1

DIRECTIONS: Solve all parts of the problem for the following circuit.



Part 1. Calculate the total resistance of the circuit.

R_T = _____

Part 2. Calculate the current of the circuit.

I = _____

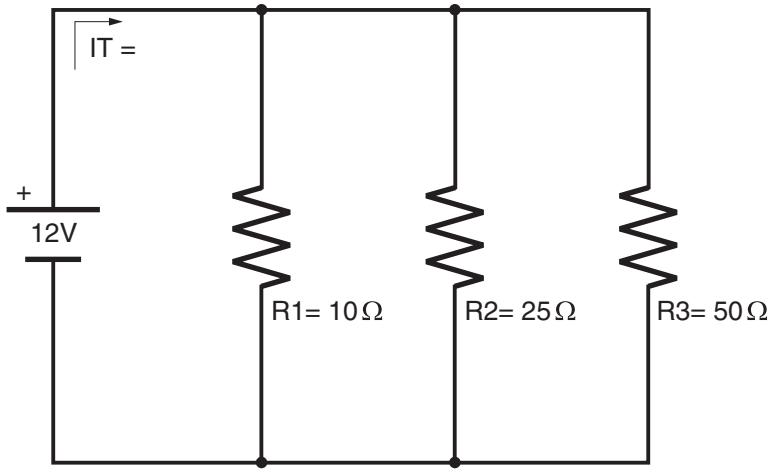
Part 3. Calculate the total power used by the circuit.

P_T = _____

Student Name:_____ Date:_____

TEST PROBLEM ES1-3-2

DIRECTIONS: Solve all parts of the problem for the following circuit.



Part 1. Calculate the total resistance of the circuit.

R_T =_____

Part 2. Calculate the main line current of the circuit.

I_T = _____

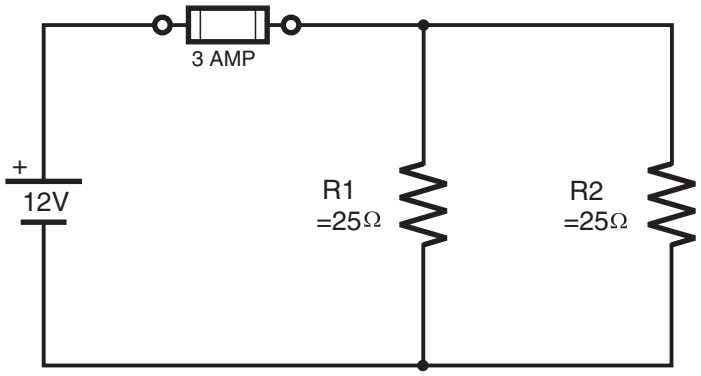
Part 3. Calculate the total power used by the circuit.

P_T =_____

Student Name:_____ Date:_____

TEST CIRCUIT ES1-3-3

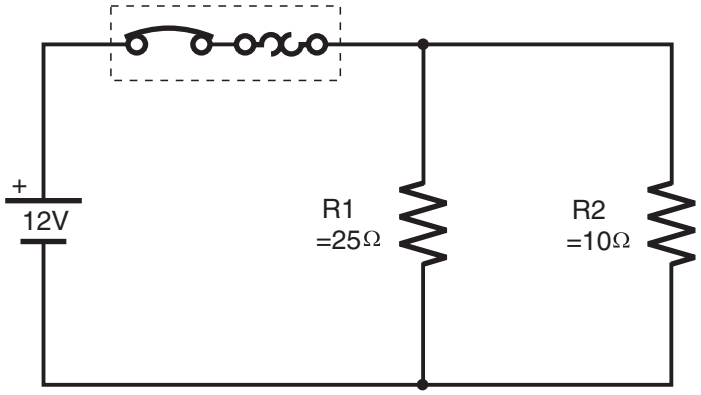
DIRECTIONS: Connect and operate the following circuit. Be prepared to answer any questions the instructor may ask.



Student Name:_____ Date:_____

TEST CIRCUIT ES1-3-4

DIRECTIONS: Connect and operate the following circuit. Be prepared to answer any questions the instructor may ask.

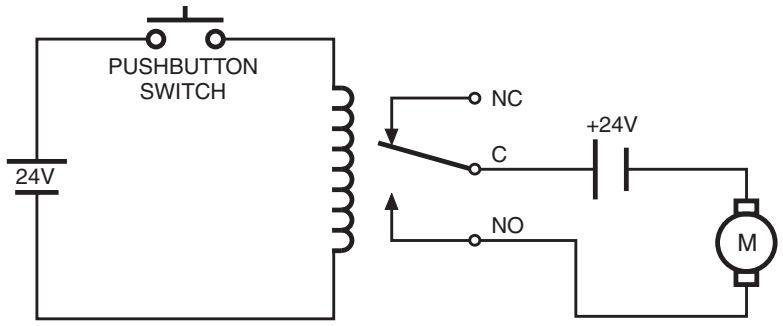


LAP 4: INDUCTANCE AND CAPACITANCE

Student Name:_____ Date:_____

TEST CIRCUIT ES1-4-1

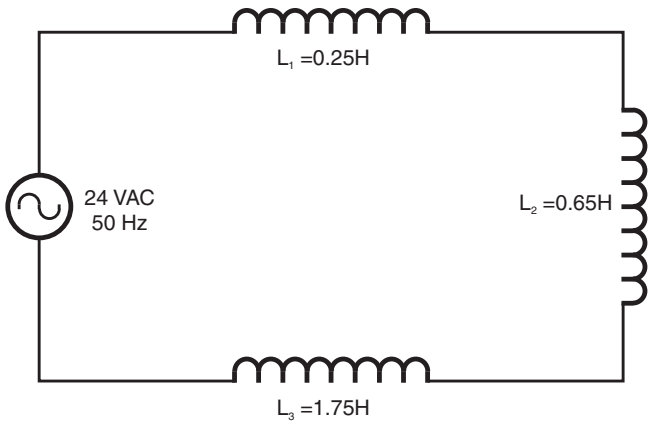
Directions: Connect and operate the following circuit. Be prepared to answer any questions that the instructor might ask concerning it.



Student Name:_____ Date:_____

PROBLEM ES1-4-2

Directions: Calculate the total load for the following circuit.



L_T = _____ (henrys)

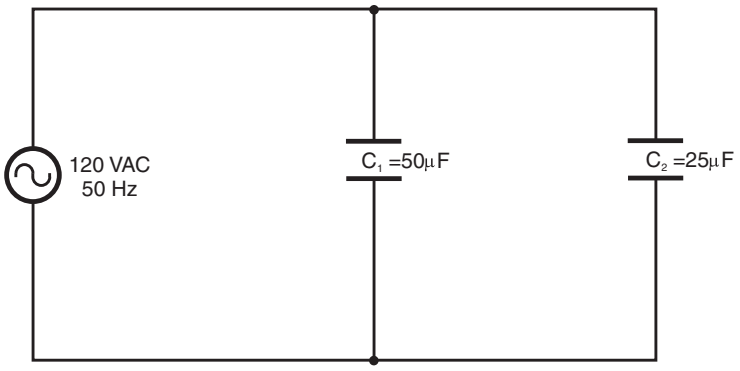
X_{LT} = _____ (Ohms)

LAP 4: INDUCTANCE AND CAPACITANCE

Student Name:_____ Date:_____

PROBLEM ES1-4-3

Directions: Calculate the total capacitance of the following circuit. The AC supply frequency is 50 Hertz.

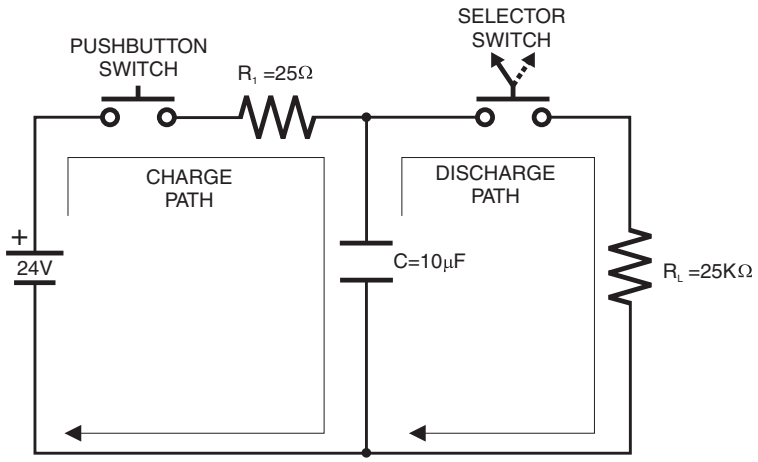


LAP 4: INDUCTANCE AND CAPACITANCE

Student Name:_____ Date:_____

PROBLEM ES1-4-4

Directions: Calculate the charge and discharge times for the following circuit.



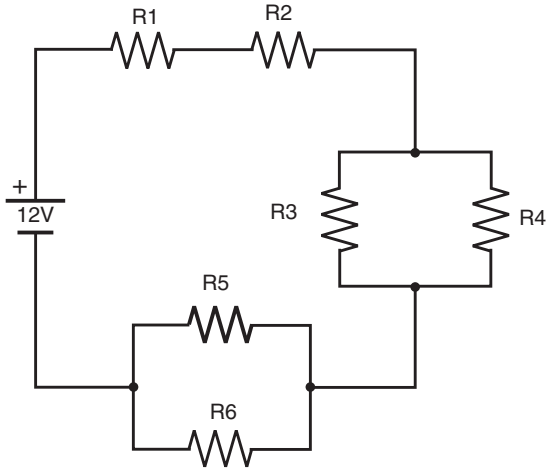
Charge time = _____

Discharge time = _____

Student Name:_____ Date:_____

PROBLEM ES1-5-1

Directions: Indicate whether the resistors in the following circuit are in series or parallel.



R_1 _____

R_2 _____

R_3 _____

R_4 _____

R_5 _____

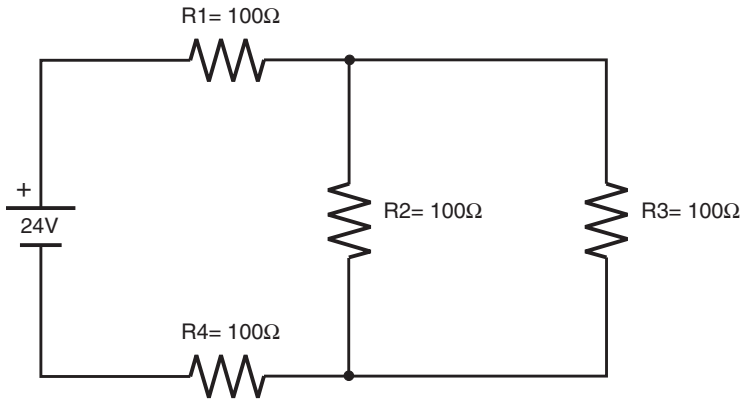
R_6 _____

LAP 5: COMBINATION CIRCUITS

Student Name:_____ Date:_____

PROBLEM ES1-5-2

Directions: Solve the following combination circuit. Redraw the circuit listing the voltages and currents for each resistor. Do your calculations on this sheet.



V_{R1} =_____ I_{R1} =_____
V_{R2} =_____ I_{R2} =_____
V_{R3} =_____ I_{R3} =_____
V_{R4} =_____ I_{R4} =_____

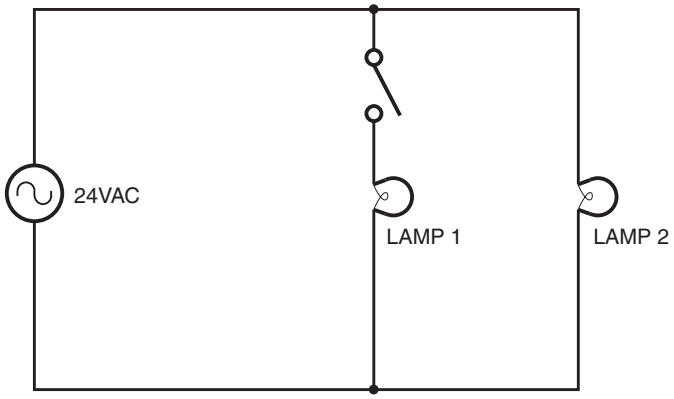
Redraw the circuit below.

LAP 5: COMBINATION CIRCUITS

Student Name:_____ Date:_____

PROBLEM ES1-5-3

Directions: Connect the following circuit and demonstrate its operation for your instructor.

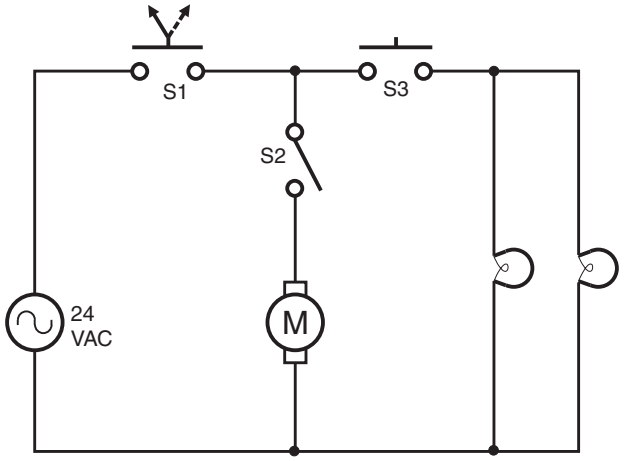


LAP 5: COMBINATION CIRCUITS

Student Name:_____ Date:_____

TEST CIRCUIT ES1-5-4

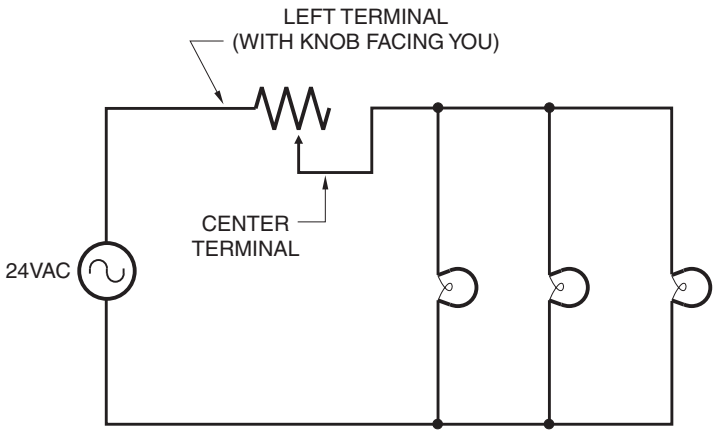
Directions: Connect the following circuit and operate it as instructed by your instructor.



Student Name:_____ Date:_____

TEST CIRCUIT ES1-5-5

Directions: Connect the following circuit and operate it according to the instructor directions. Be prepared to answer any questions the instructor might ask concerning the circuit.

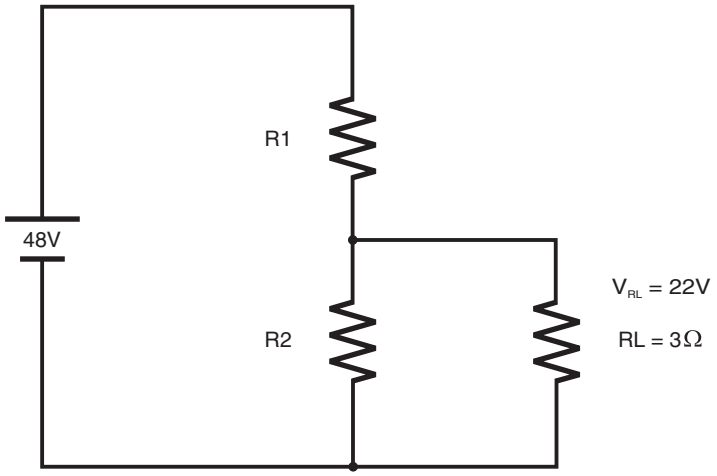


LAP 5: COMBINATION CIRCUITS

Student Name:_____ Date:_____

PROBLEM ES1-5-6

Directions: Design a loaded voltage divider for the circuit shown below.
Show your work.



R1 = _____ (Ohms)

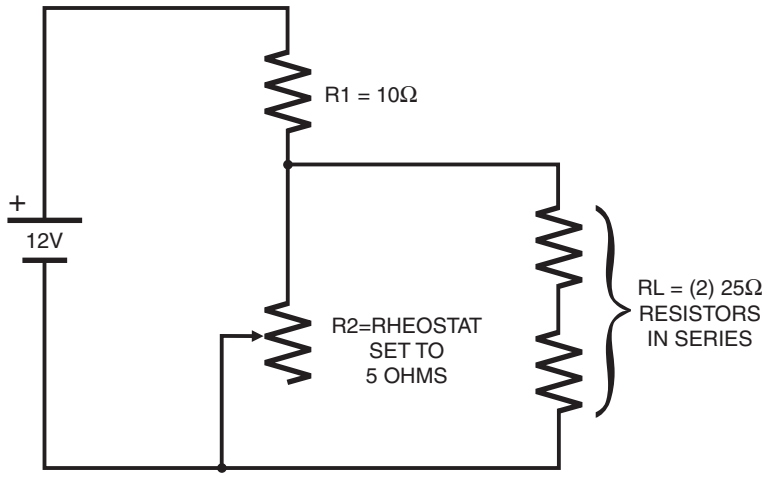
R2 = _____ (Ohms)

LAP 5: COMBINATION CIRCUITS

Student Name:_____ Date:_____

PROBLEM ES1-5-7

Directions: Connect the voltage divider circuit shown below. Be prepared to answer questions about its operation.

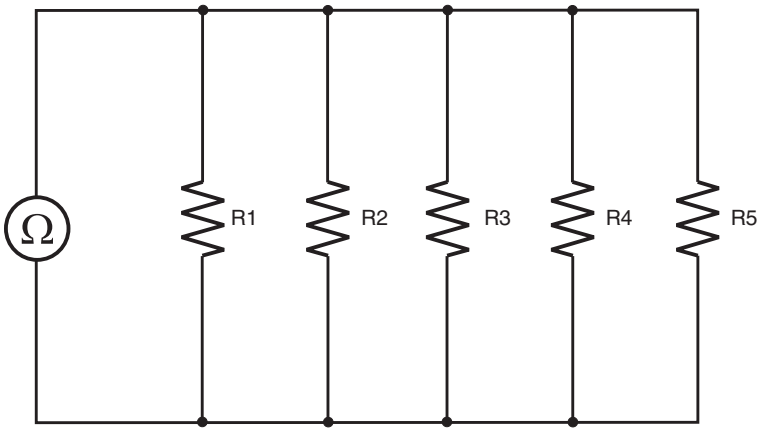


Student Name:_____ Date:_____

PROBLEM ES1-5-8

Directions: Using the schematic below and the test results listed, which resistor is shorted?

Shorted resistor = _____



Ohmmeter reading with R1 disconnected = 0 Ω

Ohmmeter reading with R2 disconnected = 0 Ω

Ohmmeter reading with R3 disconnected = 0 Ω

Ohmmeter reading with R4 disconnected = 25 Ω

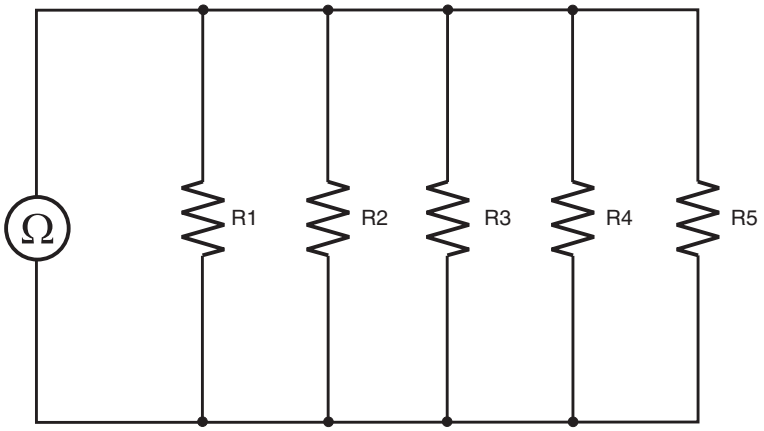
Ohmmeter reading with R5 disconnected = 0 Ω

Student Name:_____ Date:_____

PROBLEM ES1-5-9

Directions: Using the schematic below and the test results listed, which load contains an open?

Directions: Open load =_____



Ohmmeter reading when all resistors connected = 20Ω

Ohmmeter reading with R1 disconnected = 30 Ω

Ohmmeter reading with R2 disconnected = 20 Ω

Ohmmeter reading with R3 disconnected = 40 Ω

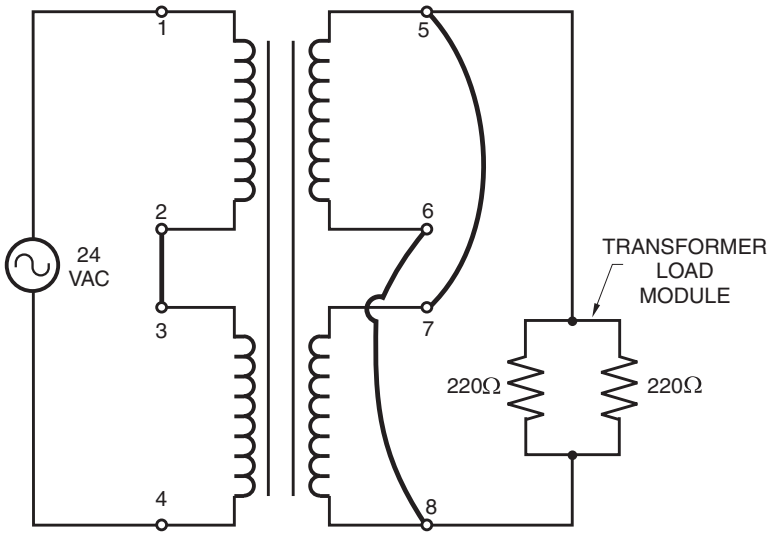
Ohmmeter reading with R4 disconnected = 100 Ω

Ohmmeter reading with R5 disconnected = 50 Ω

Student Name:_____ Date:_____

TEST CIRCUIT ES1-6-1

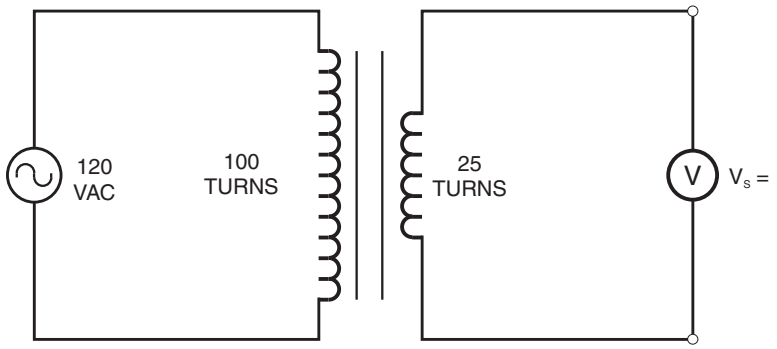
Directions: Connect and operate the following circuit and be prepared to perform any measurements or answer any questions as directed by your instructor.



Student Name:_____ Date:_____

TEST PROBLEM ES1-6-2

Directions: Calculate the secondary voltage for the following circuit.



Student Name:_____ Date:_____

PROBLEM ES1-6-3

Directions: Solve both parts of the problem.

Part 1 - Use the information given to determine which transformer should be selected from the chart for the application.

Line Voltage = 240 VAC

Operating voltage of machine = 120 VAC

In-rush current drawn by the machines motor = 2A.

Maximum VA of the Machine = _____

VA of Transformer Chosen = _____

TRANSFORMER ELECTRICAL SPECIFICATIONS AND ORDERING DATA (SUPPLY VOLTAGE 220 VAC)						
VA	Max. Inrush VA†	Temp. Rise	Dimensions			Model 636-
			A	B	C	
110-120 V Secondary Voltage Rating						
50	180	55°C	3-5/16"	3"	2-1/2	1111
75	218	55	3-9/16"	3-3/8	2-7/8	1121
100	273	55	3-3/4	3-3/8	2-7/8	1131
150	660	55	4-5/16	4-1/2	3-13/16	1141
250	1360	55	5	4-1/2	3-13/16	1161
500	1964	115	5-1/2	4-1/2	3-3/4	1191
1000	4014	115	6-3/4	5-1/4	4-3/8	1211
22-24V Secondary Voltage Rating						
50	180	55	3-5/16	3	2-1/2	1111-824
100	273	55	3-3/4	3-3/8	2-7/8	1131-824
150	660	55	4-5/16	4-1/2	3-13/16	1141-824
(*) Terminal Type (†) Capability VA. Refers to maximum inrush VA after calculations are made.						

Part 2 - Determine if the transformer will overload the circuit breaker.

The circuit breaker that the machine will be connected to is a 20A breaker that has three machines already connected to it drawing 15A.

Primary Current (IP) of Chosen Transformer = _____

Total Current Draw on Breaker = _____

Overload the Circuit Breaker (Yes/No)