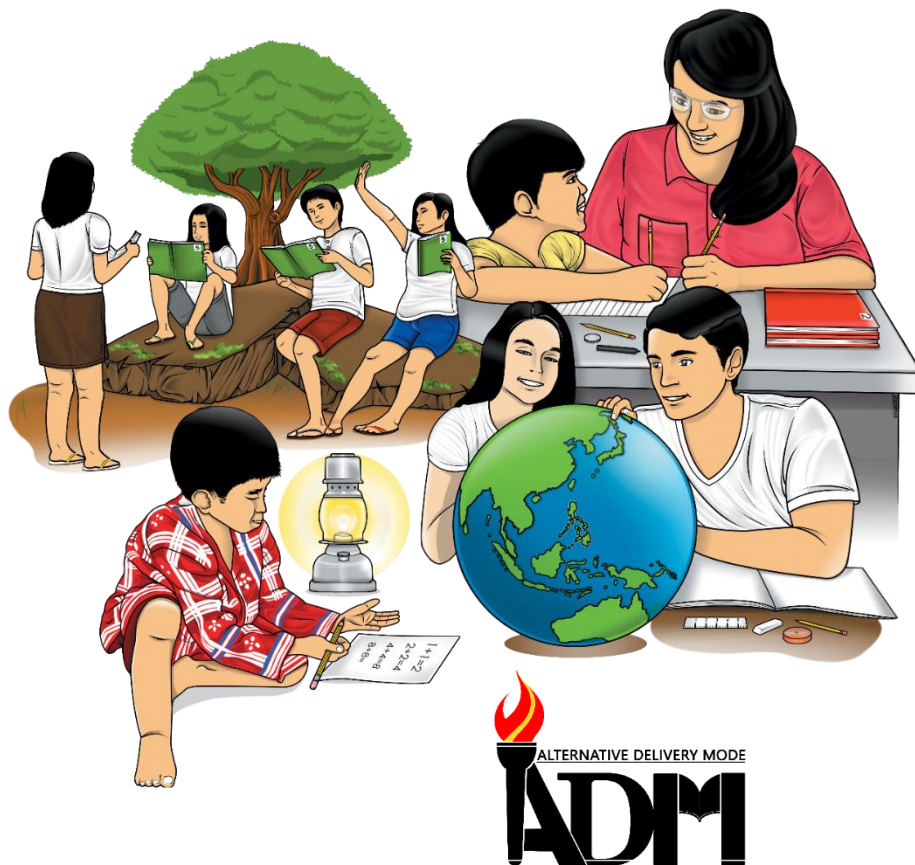


Special Program in Technical Vocational Livelihood

Quarter 1 - Module 6

Principle of Automotive Electricity

AUTOMOTIVE SERVICING NC II



Special Program in Technical Vocational Livelihood

Quarter 1 - Module 1

Principle of Automotive Electricity

AUTOMOTIVE SERVICING NC II

IA-Automotive Servicing – Grade 10

Alternative Delivery Mode

Quarter 1 – Module 6: Principle of Automotive Electricity

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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLMS is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and test. And read the instructions carefully before performing each task.

If you have questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.



Notes to the Teacher

This contains helpful tips or strategies that will help you in guiding the learner.

For the facilitator:

Hi, as a facilitator you are expected to orient the learners on how to use this module. You also need to keep track of the learners' progress while allowing them to manage their own learning. Kindly, advise the learner's parents or guardians of the same procedure since they will be the primary supporters in the learners' progress. Please, do not forget to remind the learner to use separate sheets in answering all of the activities found in the learning module

For the learner:

Hello learner, Welcome to the **Automotive Servicing NC II** Alternative Delivery Mode (ADM) **Module on the Principle of Automotive Electricity**. I hope you are ready to progress in your **SPTVE 10 in Automotive Servicing NC II** with this learning module. This is designed to provide you with interactive tasks to further develop the desired learning competencies prescribed in our curriculum. With this, you are expected to appreciate staking through the information and activity given.

This module has the following parts and corresponding icons:

ICON	LABEL	DETAIL
	What I Need to Know	This contains the learning objectives which you need to accomplish.
	What I know	This evaluates what you know about the lesson you are to learn.
	What's In	This connects the current lesson with a topic necessary in your understanding.
	What's New	This introduces the lesson through an activity.
	What Is It	This contains a brief discussion of the learning module lesson.
	What's More	These are activities to check your understanding of the lesson.
	What I Have Learned	This summarizes the important ideas presented in the lesson.
	What I Can Do	This is a real-life application of what you have learned.
	Assessment	This is a post assessment of what you have learned.
	Additional Activity	This is an activity that will strengthen your knowledge about the lesson.

At the end of this module you will also find:

References

This is a list of all sources used in developing this module.

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Answer Key	16
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LESSON 6

Prinicple of Automotive Electricity

The following are some reminders in using this module:

1. Use the module with care. Do not put unnecessary mark/s on any part of the module. Use a separate sheet of paper in answering the exercises.
2. Don't forget to answer *What I Know* before moving on to the other activities included in the module.
3. Read the instruction carefully before doing each task.
4. Observe honesty and integrity in doing the tasks and checking your answers.
5. Finish the task at hand before proceeding to the next.
6. Return this module to your teacher/facilitator once you are through with it.

If you encounter any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator. Always bear in mind that you are not alone.

We hope that through this material, you will experience meaningful learning and gain deep understanding of the relevant competencies. You can do it!



What I Need to Know

This module was designed and written to guide you to acquire the learning competencies and develop your skills in the principle of automotive electricity in IA-Automotive Servicing. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged to follow the standard sequence of the course. However, the order in which you read the module can be changed to correspond with the textbook you are now using.

Quarter/Week

Learning Competency Code

Learning Competency

Q1/W1-2

TLE_IAAUS912TRW-IIIa-b-9

LO 1. Principle of Automotive Electricity

Learning Objectives:

- a. Explain Ohm's law
- b. Explain the law of magnetism
- c. Draw the schematic diagram of an electrical circuit
- d. Illustrate signs and symbols
- e. Identify size of wires according to job requirements
- f. Determine polarity, conductor, and insulator



What I Know

Pre-Assessment

Multiple Choice

Direction: Choose the LETTER of the best answer. Write your answer in the **answer sheet**.

1. Like charges.
 - a. add
 - b. attract
 - c. repel
 - d. neutralize each other
2. The ____ is a unit of electrical pressure.
 - a. ampere
 - b. Coulomb
 - c. volt.
 - d. ohm
3. Which unit of electricity does the work in a circuit?
 - a. ampere
 - b. Coulomb
 - c. volt.
 - d. ohm
4. If 12V is applied to a resistance of 3 ohms, ____ amperes will flow.
 - a. 3
 - b. 4
 - c. 6
 - d. 12
5. Ohm's law is ..
 - a. $E = IR$
 - b. $V = IR$
 - c. $R = AI$
 - d. $A = RC$
6. Electrical current used in vehicle electrical system is:
 - a. AC
 - b. DC
 - c. both ac and dc
 - d. neither ac nor dc
7. Discovered the ohm's law.
 - a. Alexander Volta
 - b. Andrie Marie Ampere
 - c. Benjamin Franklin
 - d. Georg Simon Ohm
8. Measures the flow of current.
 - a. ammeter
 - b. hydrometer
 - c. speedometer
 - d. tachometer
9. Converts mechanical energy into electrical energy.
 - a. alternator
 - b. capacitor
 - c. diode
 - d. transistor
10. It will not allow electrons or electric current to flow through it.
 - a. conductor
 - b. insulator
 - c. motor
 - d. both conductor and insulator

11. It refers to the first known type of electricity.
- a. Current electricity
 - b. Hydro Electricity
 - c. Solar Electricity
 - d. Static electricity
12. The positively charge particle of an atom.
- a. electron
 - b. neurons
 - c. proton
 - d. none of these
13. The negatively charge particle of atom.
- a. electron
 - b. neurons
 - c. proton
 - d. none of these
14. This circuit is connected from positive terminal to negative terminal.
- a. parallel circuit
 - b. series circuit
 - c. series/parallel circuit
 - d. none of these
15. Refers to the complete path of an electric current including the current source.
- a. ammeter
 - b. circuit
 - c. diode
 - d. resistor



What's In

Direction: Put your answer in the answer sheet.

1. What is the main purpose of the battery?

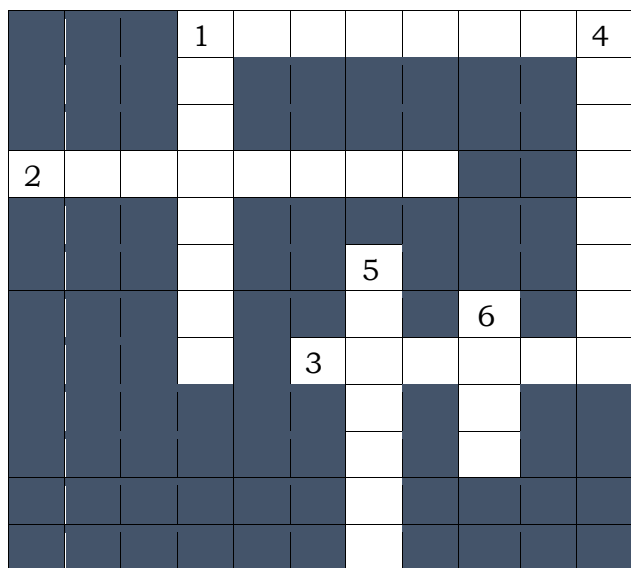
Main purpose of the battery

What's New

Activity: Crossword Puzzle

Direction: Answer the crossword puzzle to open your mind about the topic to be discuss in the next page. Put your answer in the answer sheet.

Activity 1. Crossword Puzzle



ACROSS

1. Big size terminal of the battery.
2. Small size terminal of the battery
3. Positively charge particle of atom

Down

1. Current flows in different
4. Negatively charge particle of atom
5. Complete path of current
6. Smallest particle of matter



What Is It

PRINCIPLES OF AUTO-ELECTRICITY

The word *electricity* comes from the Greek word *elektron*, meaning “amber” (a fossil resin). The ancients produced electric charges by rubbing amber with wool. This produced *static* electricity, which was the first known type of electricity. It is called “static” (motionless) because the charge is at rest and not moving through a wire.

There are three particles of an atom:

Proton is positively charged.

Neutron has no charge or neutral particles.

Electron is negatively charged particles.

Two types of electric current:

Direct Current (DC) – when the free electrons are moving in a constant direction.

Alternating Current (AC) – when the direction and motion and the size of the current vary periodically with time.

Three types of circuit:

Series circuit – devices are connected positive terminal to negative terminal. The same current flows through all the devices in the circuit.

Parallel circuit – devices are connected across each other. The current flows in different directions

Series/Parallel circuit – a combination of series and parallel circuit.

OHM’S LAW

A German physicist, Georg Simon Ohm (1787-1854), established that electric pressure (EMF) in volts, electrical resistance in ohms, and the amount of current in amperes flowing through any circuit are all related.

As the electric pressure goes up, more electrons flow. Increasing the voltage increases the ampere of current. However, increasing the resistance decreases the amount of current that flows. These relationships can be summed up in a statement known as Ohm’s law.

Ohm's law can also be stated as a simple formula that can be used to calculate one value of an electrical circuit if the other two are known:

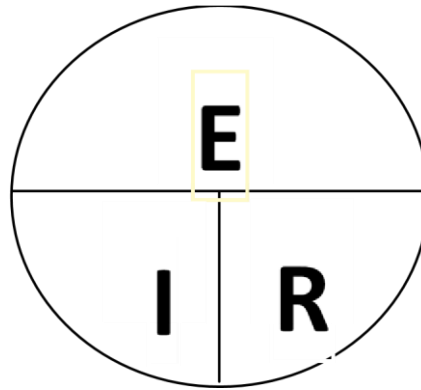


Fig.1. Formula used in Ohm's Law

Voltage is equal to current times resistance:

$$E = IR$$

Where:

I = current in amperes (A)

E = electromotive force (EMF) in volts (V)

R = resistance in ohms (Ω)

LAW OF MAGNETISM

Magnetism is the ability either natural or produced by a flow of electric current, to attract iron. Two forms of Magnetism are natural and electromagnet.

Two important facts about magnetism:

1. Magnetism can produce electricity.
2. Electricity can produce magnetism and magnetism produced by a flow of electric current is called "electromagnet".

ELECTROMAGNET – a coil of wire (usually around an iron core) that produce magnetism as an electric current passes through it.

Two kinds of Magnetic Poles:

1. North pole–the pole from which the magnetic line of force leave a magnet.
2. South pole – the pole at which the magnetic lines of force enter a magnet.

It was also discovered that “like” charged objects (both positive or both negative) repelled or moved away from each other. “Unlike” charged objects (one positive and one negative) attracted or moved toward each other.

Magnetism is the ability either natural or produced by a flow of electric current, to attract iron. Two forms of Magnetism are natural and electromagnet.

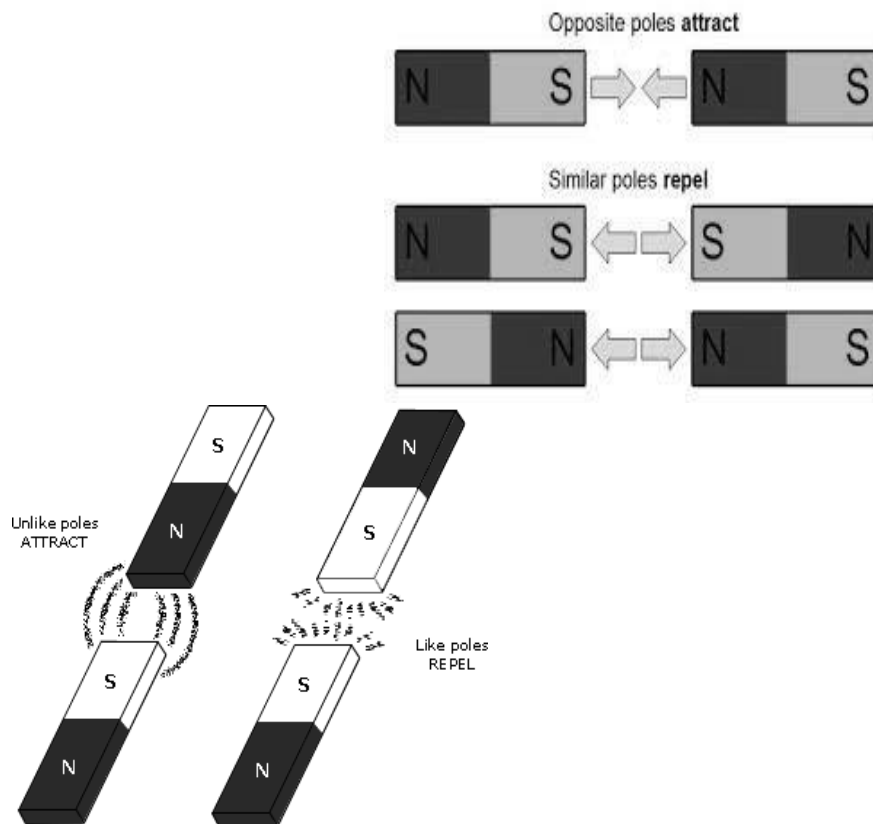


Fig. 2. Unlike charges attract while like charges repel.

AUTOMOTIVE ELECTRICAL CIRCUITS

CIRCUIT – is the complete path of an electric current including the current source. When the path is continuous, the circuit is closed and current flows. When the path is broken, the circuit is open and no current flows.

SCHEMATIC DIAGRAM OF AN ELECTRICAL CIRCUIT

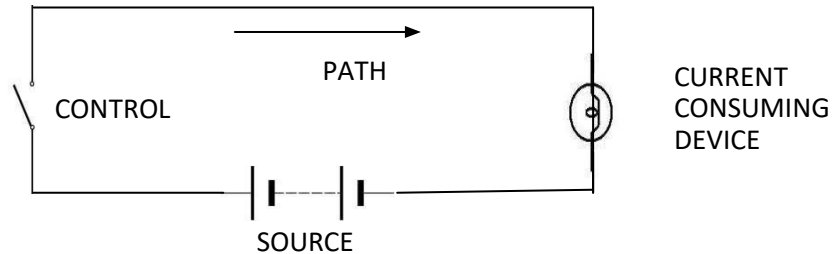


Fig.3. Complete Parts of a Circuit.

CONNECTING PARTS OF A COMPLETE CIRCUIT

Every complete circuit contains the following parts:

A power source, such as a car's battery.

Controller is used to open and close the flow of current and protection from harmful overloads (excessive current flow). Fuses, circuit breakers, and fusible links are examples of electrical circuit protection devices.

A path for the current to flow through from the power source to the resistance (a light bulb in this example) is usually an insulated copper wire.

The electrical "load" or resistance – is an opposition to the flow of electric current. Anything that consumes electricity is a resistance.

AUTOMOTIVE ELECTRICAL TERMS AND SYMBOLS

No.	TERMS	SYMBOL
1	Ammeter – It measures the flow of current.	
2	Battery –stores chemical energy and converts it into electrical energy.	

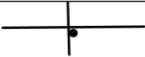
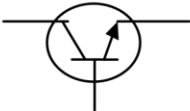
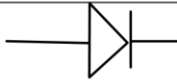
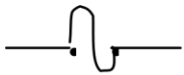
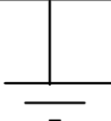
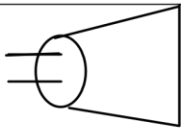
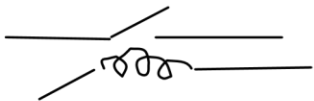
3	Wire connected - crossed wires with a block dot at the junction are joined.	
4	Connector with plug and socket - the connection maybe temporary, or serve as a permanent electrical joint between two wires or devices.	
5	Light - current flow through a filament causes the filament to heat up and emit light.	
6	6. Transistor - a solid state device typically used as an electronic relay, it stops or passes current depending on this applied voltage to its base.	
7	Capacitor (Condenser) - a small holding unit for temporary storage of electrical charge.	
8	Wire not connected - crossed wires without a block dot at the junction are not joined.	
9	Diode - a semiconductor which allows current flow in only one direction.	
10	6. Fuse - a thin metal strip which burns through when too much current flows through it.	
11	Ground - the point at which wiring attaches to the chassis, thereby providing a return path for an electrical circuit, without a ground for other return path, current cannot flow.	
12	Horn - An electric device which sounds an audible signal.	
13	Relay - an electrically operated switch where the current flow through a small coil creates a magnetic field which either closes or opens an attached switch.	
14	Switch - which continuously passes current through one set of contacts or the other.	
15	Motor - a power unit which converts electrical energy into mechanical energy, especially rotary motion.	

Fig. 5. Show various Automotive Electrical Symbols and Functions.

DIFFERENT SIZES OF WIRE ACCORDING TO JOB REQUIREMENT

The size of each wire depends on the amount of current the wire must carry. The heavier the current, the larger the wire must be. The wires are gathered together to form wiring harnesses.

Each wire is identified by the color of its insulation. For example, wires are light green, dark green, blue, red, black with a white tracer, and so on. The car manufacturer's shop manuals have illustrations that show the various wires and their colors. If you ever have to trace a particular wire, refer to the shop manual to determine its color.

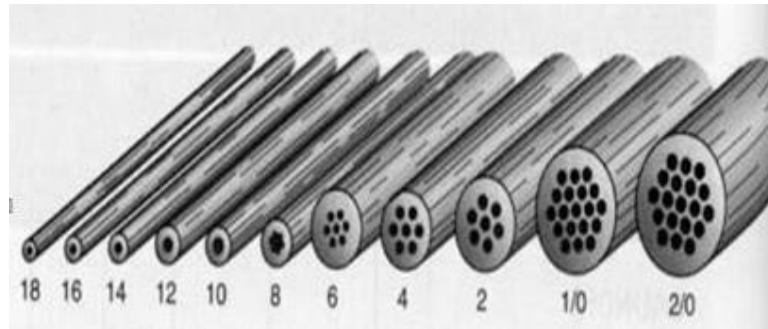


Fig. 6. Sizes of copper wire conductors.

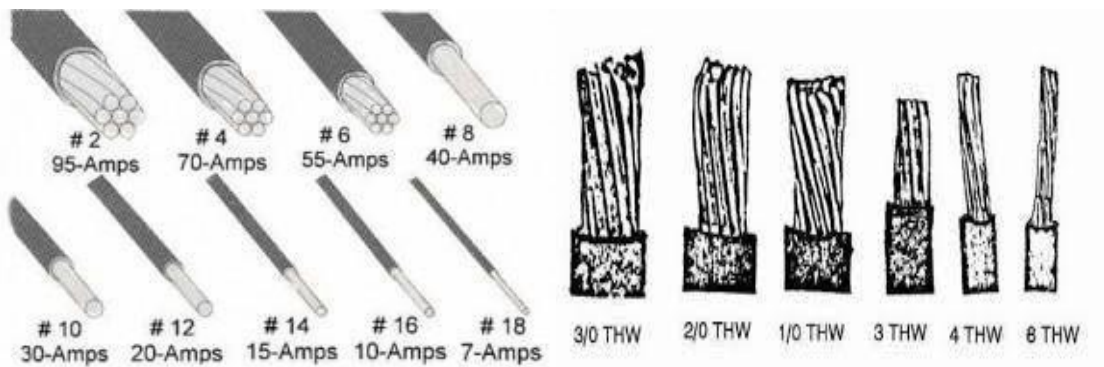


Fig. 7. Sizes of wires with corresponding Amperes.

POLARITY, CONDUCTOR, AND INSULATOR POLARITY

When connecting battery in the vehicle the correct polarity is important to observe. It must be done properly, if not, it may cause damage of the diode and the IC regulator in alternator. A battery has two poles or posts. The positive battery post is usually marked POS, or (+) and is larger than the negative post which is usually marked NEG, or (-). It has also rings in both terminals, the color is red in positive terminal and either blue or green in the negative terminal. The polarity of the battery must always match to avoid damage of the electrical wirings.

CONDUCTORS

Conductor is any material or substance that allows current or heat to flow easily. The purpose is for conduction of electrical current.

Copper is an example of an excellent conductor because the price is reasonable compared to the relative cost of other conductors with similar properties. Conductors are also classified as metals. Iron, steel, copper, aluminum, silver, and gold are examples of metal conductors. Metals can be further defined as containing iron (ferrous metals), such as cast iron, or steel, and those metals not containing iron (nonferrous metals). Copper, silver, mercury, gold, and aluminum are examples of nonferrous metals.

INSULATORS

Wires that carry electric current are covered with insulation. Examples of insulators include plastics, wood, glass, rubber, ceramics (spark plugs), and varnish for covering (insulating) copper wires in alternator and starters. The higher the voltage, the stronger the insulation must be. Insulation is a nonconductor. It will not let electrons or electric current flow through it. An insulator has a high resistance to the movement of electrons through it.



What's More

Activity 1

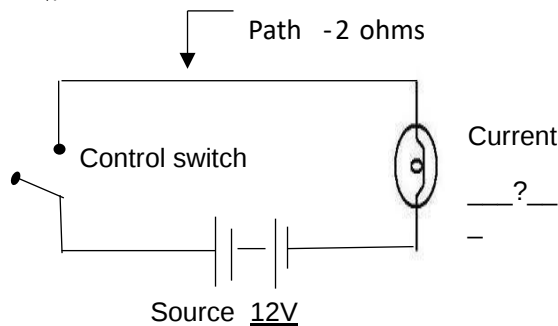
Direction: Solve the following in your **answer sheet**. Show your solution.

Problem 1.

Given:

$$E - 12 \text{ V} \quad I - 15 \text{ A} \quad R - \text{?}$$

Problem 2.



Activity 2 Identification

Direction: Identify the following question. Put your answer in your **answer sheet**.

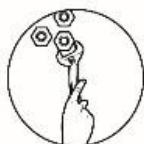
- _____ 1. A coil of wire (usually around an iron core) that produce magnetism as an electric current passes through it.
- _____ 2. A Type of electric current when the free electrons are moving in a constant direction.
- _____ 3. A type of electric current when the direction and motion and the size of the current vary periodically with time.
- _____ 4. He established that electric pressure (EMF) in volts, electrical resistance in ohms, and the amount of current in amperes flowing through any circuit are all related.
- _____ 5. The word *electricity* comes from the Greek word _____.
- _____ 6. Refers to the complete path of an electric current.
- _____ 7. The pole from which the magnetic line of force leaves a magnet.
- _____ 8. The pole at which the magnetic lines of force enter a magnet.
- _____ 9. Refers to the unit of resistance.



What I Have Learned

Direction: Answer the following question in your **answer sheet.**

Draw the schematic diagram of an electrical circuit



What I Can Do

A. Draw and level the different electrical symbols (notebook).

RUBRICS

Competencies	Drawing with Poper Labeling (20 pts)	Drawing without labeling (10 pts)
A. Draw and level the different electrical symbols		



Post-Assessment

Multiple Choice

Direction: Choose the LETTER of the best answer. Write your answer in the **answer sheet**.

1. Converts mechanical energy into electrical energy.
 - a. alternator
 - b. capacitor
 - c. diode
 - d. transistor
2. It will not allow electrons or electric current to flow through it.
 - a. conductor
 - b. insulator
 - c. motor
 - d. both conductor and insulator
3. It refers to the first known type of electricity.
 - a. Current electricity
 - b. Hydro Electricity
 - c. Solar Electricity
 - d. Static electricity
4. The positively charge particle of an atom.
 - a. electron
 - b. neurons
 - c. proton
 - d. none of these
5. The negatively charge particle of atom.
 - a. electron
 - b. neurons
 - c. proton
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 - b. series circuit
 - c. series/parallel circuit
 - d. none of these
7. Refers to the complete path of an electric current including the current source.
 - a. ammeter
 - b. circuit
 - c. diode
 - d. resistor
8. Like charges.
 - a. add
 - b. attract
 - c. repel
 - d. neutralize each other
9. The ____ is a unit of electrical pressure.
 - a. ampere
 - b. Coulomb
 - c. volt.
 - d. ohm
10. Which unit of electricity does the work in a circuit?
 - a. ampere
 - b. Coulomb
 - c. volt.
 - d. ohm
11. If 12V is applied to a resistance of 3 ohms, ____ amperes will flow.
 - a. 3
 - b. 4
 - c. 6
 - d. 12

12. Ohm's law is ..
- | | |
|-------------|-------------|
| a. $E = IR$ | c. $R = AI$ |
| b. $V = IR$ | d. $A = RC$ |
13. Electrical current used in vehicle electrical system is:
- | | |
|-------|----------------------|
| a. AC | c. both ac and dc |
| b. DC | d. neither ac nor dc |
14. Discovered the ohm's law.
- | | |
|------------------------|----------------------|
| a. Alexander Volta | c. Benjamin Franklin |
| b. Andrie Marie Ampere | d. Georg Simon Ohm |
15. Measures the flow of current.
- | | |
|---------------|----------------|
| a. ammeter | c. speedometer |
| b. hydrometer | d. tachometer |



Additional Activity

Direction: Write the function of the following lights in your notebook.

1. Headlight –
2. Stop light –
3. Directional light –
4. Dome light –
5. Park light/Clearance light –



Answer Key

What I Know

1. c
2. c
3. a
4. b
5. b
6. b
7. d
8. a
9. a
10. b
11. d
12. c
13. a
14. b
15. b

What's In

Answers may vary

What's New

- Across

 1. Positive
 2. Negative
 3. Proton

Down

 1. Parallel
 2. Electron
 3. Proton

What's More

Activity 3

- Answers may vary
1. electromagnet
 2. direct current
 3. Alternating current
 4. Georg Simon Ohm
 5. electron
 6. circuit
 7. north pole
 8. south pole
 9. ohm

Activity 2

- Prob. 1 - ans. 0.8 ohm
Prob. 2 - ans. 6 amp.

Activity 1

What I Have Learned

Answers may vary

Post-Assessment

1. a
2. b
3. d
4. c
5. a
6. b
7. b
8. c
9. c
10. a
11. b
12. b
13. b
14. d
15. a

What I Can Do

Answers vary

Additional Activity

Answers may vary

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Training Regulations of TESDA in Automotive Servicing NC II "What is a lead battery?".

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