LEARNING GUIDE

Programs Electrical

Module RENEWABLE ENERGY

Learning Unit Connecting Loads in Series

Introduction

The objective of these learning guide(s) is to introduce the student to Ohm's Law and it's values. Values such as Volts, Ohms and Amperes will be measured and calculated and compared to the readings on the multimeter.

A series circuit is a circuit that has only one path to follow. Using three lamps, determine the individual resistance and their cumulative resistance. Determine the applied voltage and connect the loads. Experiment with the connections. Configure the lamps so that one, two and three lamps are connected in series. Watch the lamps diminish in intensity and measure the voltage drop across each lamp, and each lamp's individual resistance. Use this data to calculate total voltage, voltage drop, total resistance, individual resistance and amperage.

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Connecting loads in series

Performance Objective: The student will design a series circuit consisting of photovoltaic cells, wire and incandescent lamps and observe how the circuitry is completed and note the effects of voltage drop and how it affects the intensity of the incandescent lamps depending on how many are connected in series. Ohms Law will be explored and calculations will be performed in order to establish an understanding of the effects of power consumption.

Given: An instruction sheet, schematic, instructor lecture, photovoltaic panel(s), miniature lamps and holders, wire and appropriate tools (not limited to but to include a multimeter, side cutting pliers, screwdrivers and a protractor).

The Student Will: Assemble and test a small photovoltaic panel in series, measure the values and compare them to the calculations performed using Ohms Law. Using the panels as a source of power, connect the lamps and explore the effects of various total resistances. This will cause the lamps to vary in intensity.

How Well: You must successfully pass a knowledge test and a performance test.

NAME: _____

DATE: _____

GRADE: _____

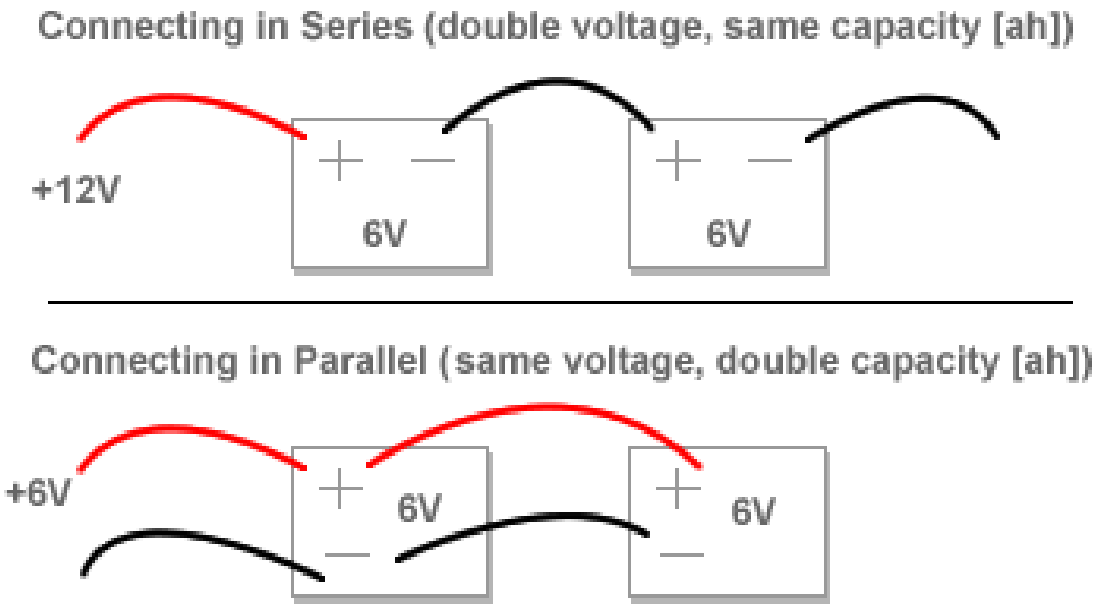
INSTRUCTION SHEET

Series Circuits are circuits are circuits, which have only one path for electricity to follow. This means that if the continuity of the circuit is broken (opened), there is no current flow. Therefore, the electrical device cannot operate. When voltage sources such as photovoltaic cells are combined in series, voltage is increased in an additive fashion. This is proven in the experiment by adding photovoltaic panels and measuring the output as panels are added.

Likewise, resistances are added in an additive fashion. When more resistance is added, it causes less current to flow. A voltage drop across each lamp and a drop in ampereage will show this.

Reading Assignment:

Delmar's Standard Textbook of Electricity
Written by Stephen L. Herman
Series Circuits, Section Two



COMPONENTS

Amp: Also known as Amperes. Amperes are a quantitative measure of current flow. Indicating the number of electrons flowing through a conductor.

Current output: The quantity of amperes flowing through the circuit at a particular time.

Multimeter: A tool used to measure the quantities of voltage and current for the purposes of testing and evidencing the presence of electricity.

Photovoltaic System/Cell/Panel: Electric generating devices, which directly convert sunlight into electricity, are made of silicon.

Series connection: A wiring configuration, which has only one path for current to flow.

Volt: Also known as potential. The unit used to measure the force of electricity in a circuit.

Watt: A function of volts multiplied by amperes. A watt is a standard unit of power usage.

Wire: Also known as a conductor. A wire is an insulated piece of copper used to carry electricity from one place to another.

Massachusetts Frameworks/Technology (HS)
5. Energy and power Technologies-Electrical Systems
Broad Concept: Electrical Systems generate, Transfer, and Distribute Electricity

5.1 - Describe the different instruments that can be used to measure voltage.
5.2 – Identify and explain the components of a circuit including a source, conductor, load and controllers.
5.3 – Explain the relationship between resistance, voltage, current and Ohm's Law.
5.4 – Determine the voltages and currents in a series circuit and a parallel circuit.
5.5 – Explain how to measure voltage, resistance and current in an electrical circuit.
5.6 – Describe the differences between Alternating Current (AC) and Direct Current (DC)

Massachusetts Frameworks/Science (HS)
Broad Concept: Stationary and moving charge particles result in the phenomenon known as electricity and magnetism.

5.4 - Develop a qualitative and quantitative understanding of current, voltage, resistance and the connection between them.
5.5 – Identify appropriate units of measurement for current, voltage and resistance and explain how they are measured.
5.6 – Analyze circuits (find the current at any point and the potential difference between any two points in the circuit) using Kirchoff's and Ohm's Laws.

KNOWLEDGE TEST

Directions

Evaluate your knowledge by achieving “Proficient” on the following question.

Explain how the series connection affects the voltage reading on the meter. Include how this is relative to the number of panels connected and how it subsequently affects this reading.

Grading Rubric

Mastery
Complete and accurate account including correct terminology, direction, and usage of meters.

Proficient
Basically accurate account, student lacks a complete understanding of component operation

Needs Improvement
Incomplete data, does not understand the operation of the system

PERFORMANCE TEST

Directions

Given access to a work station, the proper tools, and the schematic drawing in this learning guide, you will design and install all of the components required for a solar photovoltaic system. You will be evaluated for attainment of this task based on the items listed below.

Performance Standards

All items must be marked YES for attainment

		Yes	No
PROCESS			
1.	Were all safety rules observed?		
2.	Are all components installed as per drawing?		
3.	Are all components installed in proper sequence?		
4.	Are all straight and neat?		
5.	Were all meters used properly?		
6.	Are all terminations tight?		
7.	Was the installation in accordance with the National Electrical Code?		
8.	Did the student return all excess materials and tools to the designated area?		

List of RESOURCES

Delmar's Standard Textbook of Electricity
Written by Stephen L. Herman