LEARNING GUIDE

Programs Electrical

Module RENEWABLE ENERGY

Learning Unit Determining Power Consumption

Introduction

The objective of these learning guide(s) is to introduce the student to the concept of power as in wattage. Using the previous values such as Volts, Ohms and Amperes the student will determine total wattage and compare it to the wattage of the photovoltaic panels.

Wattage is a function of voltage multiplied by amperage. Expressed in a mathematical formula as P=EI where P=Wattage, E=Volts and I=Amps.

This is important because in order to size the photovoltaic panels appropriately you will have to first determine the connected load. From that, you need to consider voltages and wire sizes.

Written by:
John Sannizzaro
Upper Cape Cod Regional
Technical High School

UPPER CAPE COD REGIONAL TECHNICAL HIGH SCHOOL

Determining power consumption

Performance Objective: The students will calculate the total load in wattage of a circuit consisting of incandescent lamps wired in parallel and determine the appropriate size of the necessary photovoltaic panel necessary based on how the loads are to be connected. The students will connect the photovoltaic panels and lamps in either series or parallel depending on the needs of the circuit requirements.

Given: An instruction sheet, schematic, instructor lecture, photovoltaic panel(s), calculator, 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 photovoltaic panels and incandescent lamps in series and parallel according to the requirements of the panels and lamps. Using the panels as a source of power, connect the lamps and explore the effects of total resistance and how current flows. This will cause the lamps to all burn at the same intensity.

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

NAME: _____

DATE: _____

GRADE: _____

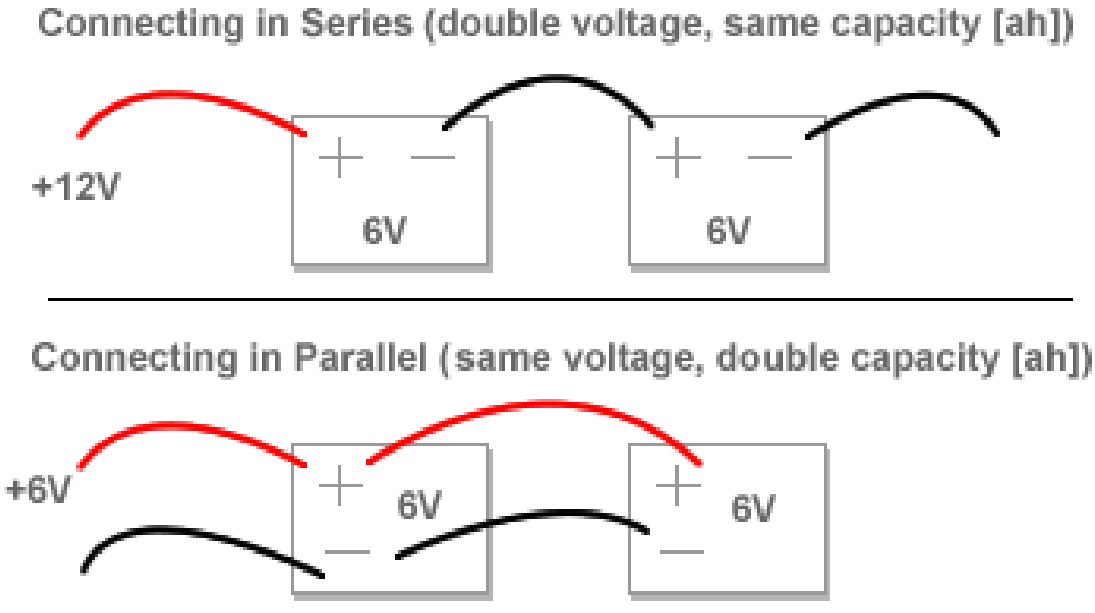
INSTRUCTION SHEET

Parallel Circuits are circuits are circuits, which have multiple paths for electricity to follow. This means that if the continuity of one of the paths is broken (opened), current will still flow through the remaining legs of the circuit. Therefore, the other electrical device(s) will continue to operate. When loads are connected in parallel, the circuit behaves differently than when it was connected in series. This is proven in the experiment by adding and removing lamps connected in parallel.

When additional paths are created in a parallel circuit, it offers more places for current to flow, causing higher total amperage in the main part of the circuit. Each lamp draws it's usual current, but is now additive like resistance was in the previous series circuit lesson.

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