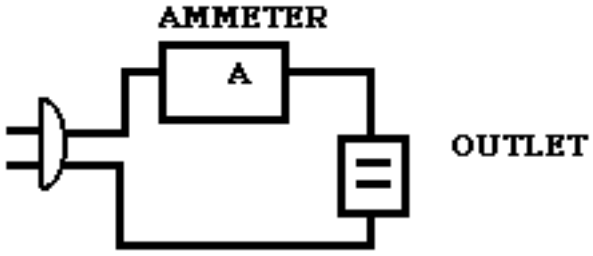
PHYSICS 162 **Name:_____.**
Winter 2005
Lab/Lecture Activity #3

EXPERIMENT #1 What's in a Watt?

Objectives:
1. To better understand the relationship between current, voltage and power.
2. To analyze series and parallel connections of electric circuits and determine why your home is connected as a parallel circuit.

PART A : RESISTANCE, CURRENT, VOLTAGE AND POWER
Ohm's law defines the amount of current that will flow through device and how it depends on the resistance. : RESISTANCE = VOLTAGE / CURRENT or **R = V/I**. CURRENT = VOLTAGE / RESISTANCE or **I = V/R** The operating power of a device is given by POWER = CURRENT * VOLTAGE or **P = I*V**. Here we will examine the current, voltage, resistance and power for several devices operating at their normal voltage, 120 V.

An ammeter (a device that measures current flow) is connected to an outlet box. When a lamp is plugged into the outlet box the ammeter will register the current flowing to that light bulb. Plug the lamp with the specified bulb into the outlet box. Turn the power on and record the current in amperes (A) in the table below. Calculate the resistance in ohms (Ω) and the power in watts (W).



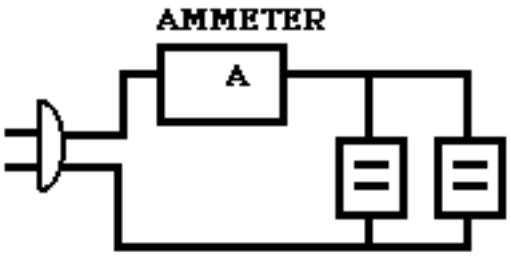
DATA

BULB VOLT (V)	**CURRENT (A)**	**RESISTANCE (Ω)**	**POWER(W)**
	(V)	**(I)**	**(R=$\frac{V}{I}$)**	**P = I*V**
40 Watt	120			
60 Watt	120			
100 Watt	120			

Question: How does the current relate to the rated wattage of the bulb?

PART B: CURRENT AND VOLTAGE IN PARALLEL CIRCUITS

A parallel circuit is one where the devices are wired in such a way that current can independently flow through any branch.



Outlets Wired in parallel

To observe the effect of the total current of outlets connected in parallel you will plug in two lamps with different wattage light bulbs and measure the current.

1. Plug a 40 watt light bulb into one of the outlets. Apply power and measure the current.
2. Plug a 60 watt bulb into a second outlet and record the current.

DATA

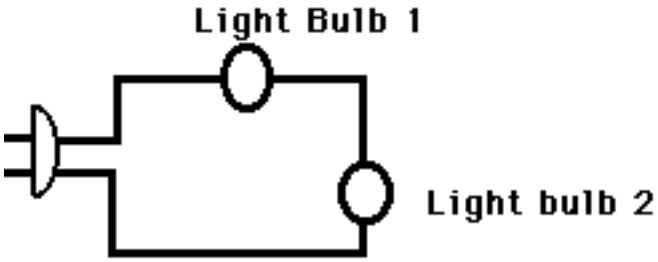
BULB(s)	**VOLT (V)** **(V)**	**CURRENT (A)** **(I)**	**RESISTANCE (Ω)** **($R=\frac{V}{I}$)**	**POWER(W)** **P = I*V**
40W	120			
60W+40W	120			

Question: Compare the results to the currents in Part 1 and determine if the currents measured for the individual bulbs add up to the measured currents in Part 2.

Observation: When you have the two lights plugged in, what happens to the one light bulb when you unscrew the other light bulb?

PART C: PHYSICS ELECTRIC LAB DEMONSTRATIONS:

Series Circuit



Light Bulbs Connected in Series

Here we will observe some characteristics of a series circuit. Note the difference between how the light sockets are connected in this circuit as compared to the sockets diagram in Part 1. They are connected in **series,** the current must flow through bulb one and then bulb two.

At this **supervised** station observe the following.

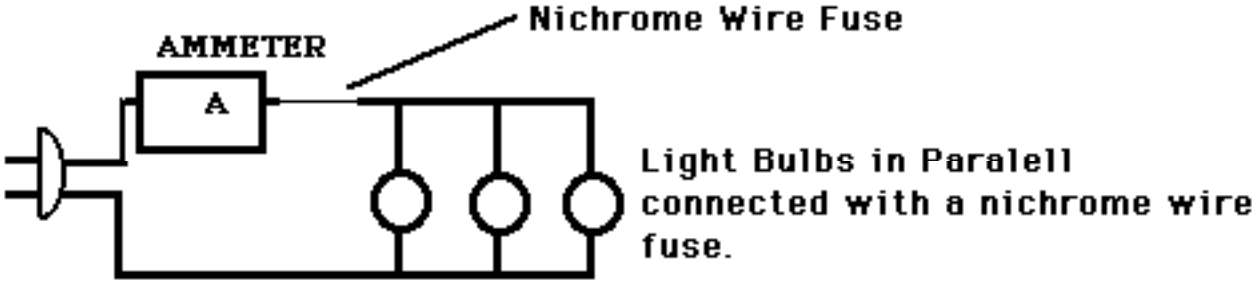
1. How does the brightness of the two bulbs in series compare to the bulb that is plugged directly into the wall? (Note: All three bulbs are of identical wattage.)

(The difference that you see is due to the fact that the voltage divides itself between the two bulbs.)

2. Notice what happens when you unscrew one light bulb. Why does the other bulb go out?

Fuse Demo:

Again, this is at the supervised station.



The three light bulbs are connected in parallel (just like plugging three lamps into a wall socket) with a piece of nichrome wire connected in series with them. The nichrome wire acts as a fuse or circuit breaker. As you will see it will allow current to flow up to a certain amount...and then...poof!

1. Screw in each light bulb and observe the current after each one.

2. Describe what happened as each bulb was screwed in.

3. We will now slowly increase the voltage and determine what current causes the fuse to go .

_____Amps

Discussion Questions:

1. Why are the electrical circuits in your house connected in parallel?

2. Have you had any experience with devices wired in series?

3. Why are fuses and circuit breakers connected in series with electrical circuits or devices?

EXPERIMENT 2 Energy Conversion: Gravitational Potential Energy to Electrical Energy

Purpose:

The purpose of this part of the lab is to examine the conversion of potential energy to usable electrical energy. The setup consists of a pulley wheel attached to a small generator. A piece of rubber tubing is run through the pulley wheel. Dropping a mass attached to the rubber tubing will turn the wheel and generate electricity, heating up a resistor. An ammeter and voltmeter are connected to the setup so that you can measure the current generated by the falling mass and the voltage across the resistor. Measuring the current and voltage produced, and the time it takes the mass to fall one meter, will enable you to calculate how much of the potential energy of the falling mass is being converted into light and heat. Also measure the height h that the mass falls and release the mass from the same height for each measurement.

EXPERIMENT:
PART A:

First connect a light bulb to the leads of the generator and connect a 0.5kg mass to the rubber tubing. Determine and measure the height you will drop the mass from. Drop the mass a couple of times and observe what happens to the bulb as the mass falls.

h = _____ meters

Drop the mass with the leads disconnected from the light bulb. Does the mass fall faster or slower...Why?

PART B:
Connect the resistor and meters to the generator leads. With the 0.7kg mass on the tubing. measure the current produced, the voltage across the resistor, and the time it takes for the mass to fall the distance h. Take about three measurements and enter them in the data table below

V = voltage (in Volts) P = power = V x I (in Watts) I = current (in Amps)
t = time (in seconds) E = energy = P x t (in Joules)

DATA: 1 kg mass

trial #	V (volts)	I (Amperes)	P = I*V (Watts)	t (seconds)
1				
2				
3				
Average	#########	################		

CALCULATIONS:

Average Energy: ($E = P_{average} * t_{average}$) =_____ Joules

Repeat with the 1.5kg mass. **Movie located at website**

DATA: 1.5 kg mass

trial #	V (volts)	I (Amperes)	P = I*V (Watts)	t (seconds)
1				
2				
3				
Average	#########	#################		

CALCULATIONS:

Average Light Bulb Energy : (E = P*t) _____ Joules

PART C:

Calculate the efficiency of this energy conversion process.

Efficiency = Energy out / Energy in.

EFFICIENCY OF 0.7kg MASS:

Energy in = gravitational potential energy = mgh = _____ Joules

Energy out = Pt = _____ Joules

$$\text{Efficiency: } = \frac{\text{Energy Out}}{\text{Energy In}} \times 100 = \_\_\_\_\_ \%$$

EFFICIENCY OF 1kg MASS:

Energy in: _____ Joules

Energy out: _____ Joules

$$\text{Efficiency: } = \frac{\text{Energy Out}}{\text{Energy In}} \times 100 = \_\_\_\_\_ \%$$