PhyzLab: Current Events I

a quantitative investigation of a simple circuit

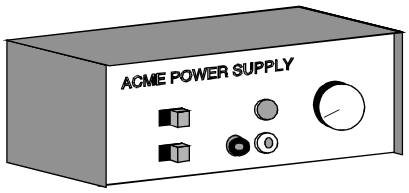
PERIOD	1.		
	2.		
GROUP	3.		
	4.		

• Purpose •

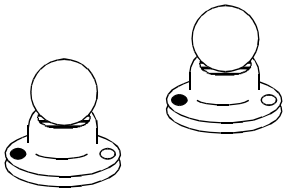
In this activity, you will make current and voltage measurements at various points in a simple circuit to see how the flow of charge and the energy of that charge are distributed throughout the circuit. This investigation will be followed by similar explorations of series circuits and parallel circuits.

• Apparatus •

___ variable DC power supply (or 6 V lantern battery)
___ miniature light bulb in **white** socket (6.3 V) [#46 or equivalent]
___ 4 connecting wires
___ DC ammeter (0-1 A range)
___ DC voltmeter with test leads (0-10 V range)



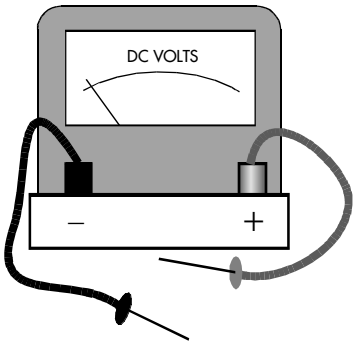
DC power supply
NOTE: black terminal is negative



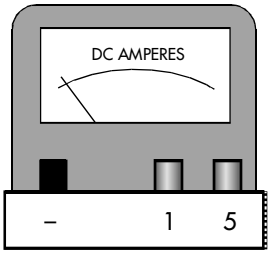
bulbs in sockets

connecting wires

THE TEST LEADS ARE ALWAYS CONNECTED TO THE VOLTMETER AND ARE NEVER CONNECTED TO THE AMMETER



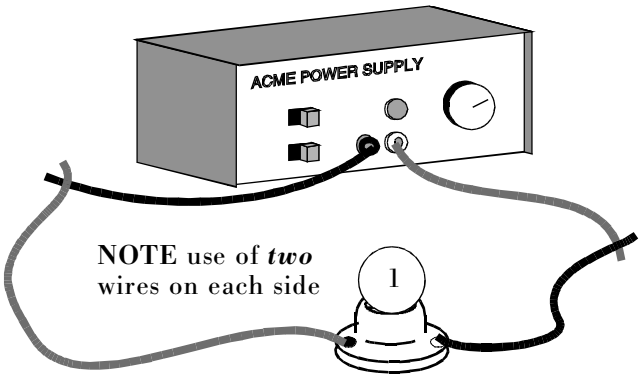
voltmeter (with test leads)



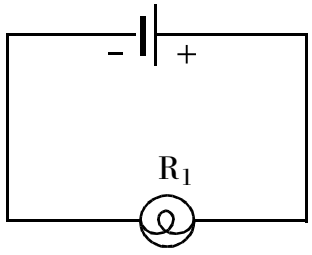
ammeter

• Procedure •

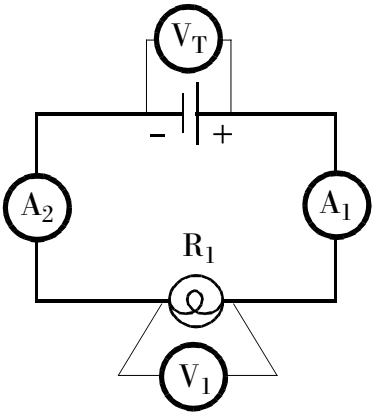
a. **Construct** a *simple* circuit using the power supply, one bulb, and **four** wires as shown below.



BASIC SCHEMATIC DIAGRAM



SCHEMATIC WITH
METER POSITIONS SHOWN



METERS

(V) – voltmeter (measures voltage; is always connected in parallel with a circuit element)

(A) – ammeter (measures current; is always connected in series)

DESCRIPTION OF MEASURED CIRCUIT QUANTITIES

V_T measures V_T, the voltage across the terminals of the power supply.

A_1 measures I_1, the current from the positive terminal of the power supply to the bulb.

V_1 measures V_1, the voltage drop across bulb 1.

A_2 measures I_2, the current from the bulb to the negative terminal of the power supply.

b. **DEFINITIONS AND PREDICTIONS**. Complete the statements and answer the questions.

i. Electric current is a measure of

ii. In this lab you will measure current using a/n

iii. This device is always connected in ___series ___parallel with other elements in the circuit.

iv. By convention we say current flows from the positive (red) terminal of the power supply to the negative (black) terminal. Look at the diagram above. In this circuit, the current is moving ___clockwise ___counterclockwise.

v. Where will there be more current? ___From the power supply out to the bulb (I_1) or ___From the bulb back to the power supply (I_2) or ___ I_1 and I_2 will be about equal to each other.

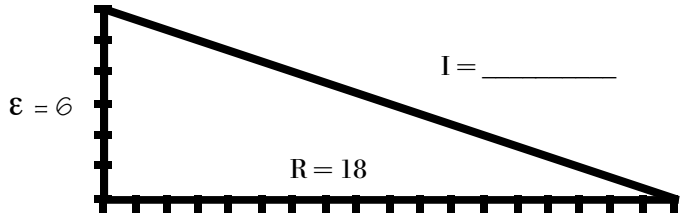
vi. Voltage (electric potential) is a measure of

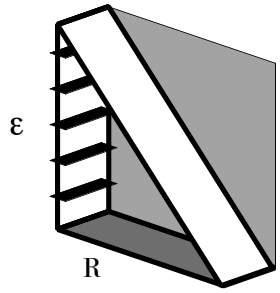
vii. The voltmeter measures differences in the energy content of the charge at various points in the circuit. The power supply creates such a difference between the charge at each of its terminals. We designate this voltage V_T. The bulb transforms the energy of the charge into heat and light, so charge loses energy while passing through the bulb. The voltage across the bulb is designated V_1. How does V_1 compare to V_T?

$V_1 > V_T$ • $V_1 = V_T$ • $V_1 < V_T$

viii. Measurements are to be made ___before ___after predictions.

ix. Consider the slide shown below. Its elevation is 6 and its run-length is 18. What is its incline (flow capacity)?





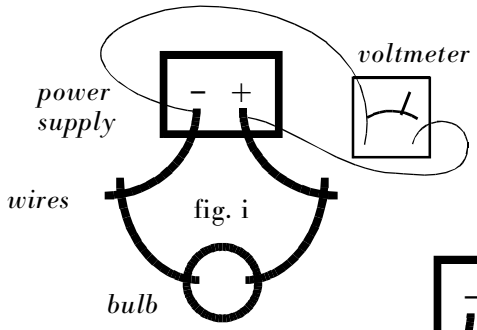
c. **Measure** the quantities V_T, V_1, I_1, and I_2. NOTE: WIRE THE CIRCUITS AS SHOWN IN THEIR RESPECTIVE DIAGRAMS AND HAVE CURRENT RUNNING THROUGH THEM WHEN TAKING MEASUREMENTS.

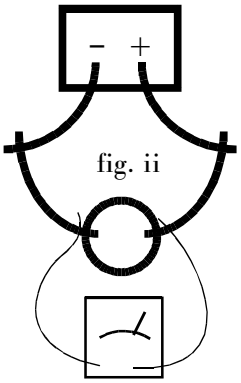
i. Touch the + and – leads on the voltmeter to the + and – terminals of the power supply. (The test leads do not need to be pushed into the terminal holes; they merely need to touch the exposed metal of the terminal or any connected alligator clips. Adjust the power supply to 6.0 V. (See figure ii.)

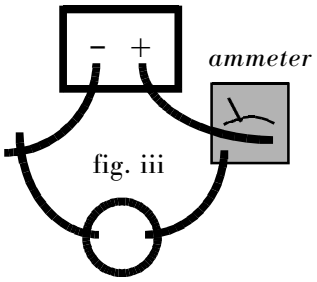
ii. Move the voltmeter's test leads from the power supply to the light bulb. Touch the leads to opposite-side connections on the socket. (See figure 2.) Record V_1 in two significant figures on the diagram below. If the voltmeter needle moves backward, reverse the leads touching the socket connections. Set the voltmeter aside.

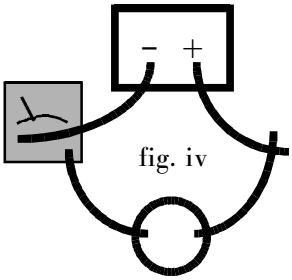
iii. Disconnect the two wires leading from the positive terminal of the power supply to the bulb from each other. Connect the ammeter in series at that point. (See figure iii.) Record I_1 in two significant figures on the diagram below.

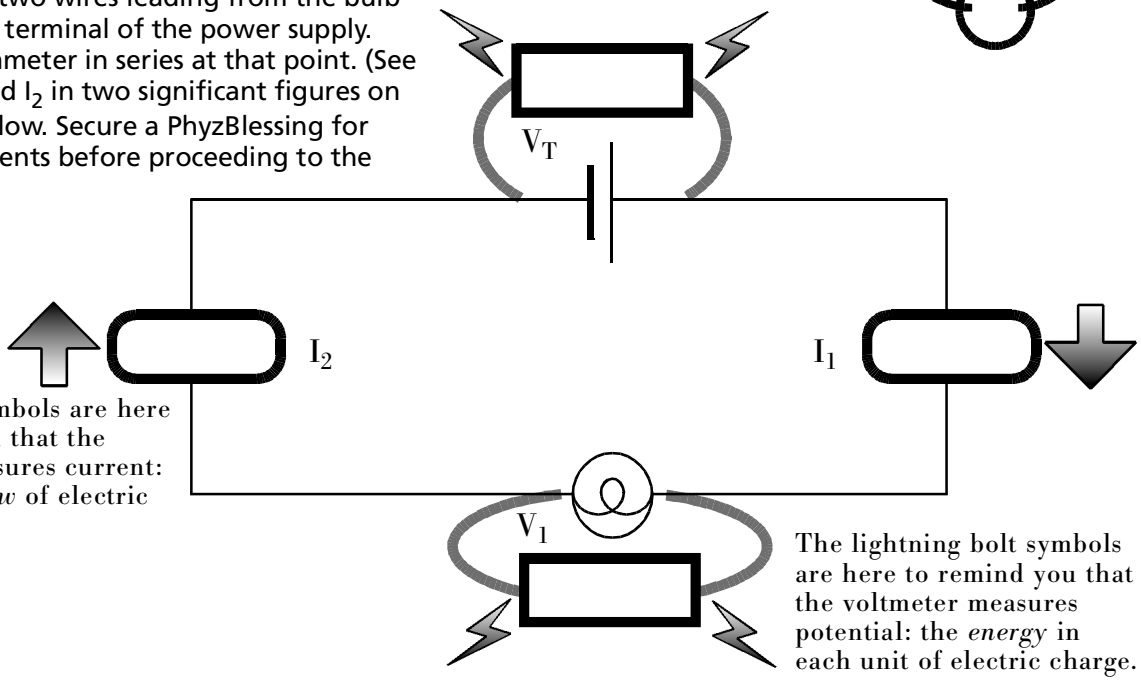
iv. Remove the ammeter and reconnect the wires. Disconnect the two wires leading from the bulb to the negative terminal of the power supply. Connect the ammeter in series at that point. (See figure iv.) Record I_2 in two significant figures on the diagram below. Secure a PhyzBlessing for your measurements before proceeding to the next activity.











The arrow symbols are here to remind you that the ammeter measures current: the *rate of flow* of electric charge.

The lightning bolt symbols are here to remind you that the voltmeter measures potential: the *energy* in each unit of electric charge.

v. Transfer these values to your "Data and Calculations" summary sheet but do not make any calculations until you reach the analysis section of the lab.

d. **Conclusions**. How did your observations compare to your predictions (from parts b. v. and b. vii.)? Did you learn anything in this activity?

• Data and Calculations •

THE SIMPLE CIRCUIT.

Terminal Voltage: V_T = _____

	Voltage (V)	Current (A)	Resistance ( )	Power (W)
1				
2				
	m e a s u r e m e n t s		**c a l c u l a t i o n s**	

• Analysis •

1. CALCULATIONS

a. Show the equation used to determine the resistance *R* of a bulb that passes a current *I* at a potential *V*.

b. Show the equation used to determine the power *P* of a bulb that passes a current *I* at a potential *V*.

c. Show a calculation to determine the resistance associated with a bulb that draws 0.25 A at 5.0 V.

d. Show a calculation to determine the power associated with a bulb that draws 0.25 A at 5.0 V.

e. Complete the data table by calculating the resistance and power values.

2. PATTERNS IN THE SIMPLE CIRCUIT

a. **Voltage.** Was there a significant difference* between the voltage across the bulb, V_1, and the voltage across the terminals, V_T? If so, which was greater?

b. **Current.** Was there a significant difference* between the current *before* the bulb, I_1, and the current *after* the bulb, I_2 (remember that—by definition—**current** flows from the positive terminal to the negative terminal)? If so, which was greater?

*A significant difference is one that is 20% or more. The percent difference between two numbers, *a* and *b*, is

$$\%D = | a - b | / (a + b) \times 200$$