LAB 57: BATTERY AND LIGHTBULB

The number of batteries used in this lab is determined by the type of lightbulbs that are used. A 3 V lightbulb will require two batteries. Students should perform this activity after being instructed how to use the multimeter. Instructions will vary based on the model of multimeter. Students will create a circuit with a battery and lightbulb and use a multimeter to analyze the circuit.

Post-Lab Answers

1. Answers will vary greatly based on the lightbulb used.
2. Answers will vary greatly based on the lightbulb used.
3. Answers will vary greatly based on the lightbulb used.
4. The biggest source of error is that the resistance of the bulb changes as it warms up. The battery and wires also heat up when in operation. The voltage of the battery when it is in use can be different than when it is not in use.

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QUESTION ❓

What are the resistance, voltage, and current of a circuit with a battery and lightbulb?

SAFETY

Do not touch the lightbulb; it can get hot. Handle batteries carefully; they may get hot.

MATERIALS

2 D-cell batteries, lightbulb, 4 6-in. wires stripped at both ends, multimeter

PROCEDURE

In this lab, you will be connecting a small lightbulb to a battery and measuring the resistance, voltage, and current in the circuit. It is important to remember that a voltmeter is connected in parallel to (across) the object being measured and an ammeter has to be inserted into the circuit by breaking the circuit and having it pass through the meter. Be sure that you know how to connect the ammeter or you will damage the meter.

1. Use the multimeter to measure the voltage of the battery. Be sure that the meter is set on DC volts and set around 5 or 10 V. Touch the red probe to the positive terminal (marked on the battery) and the black probe to the negative terminal.
    _____ V
2. Now stack two batteries on top of each other (in series with each other) and measure the voltage again from the top of one battery to the bottom of the other.
    _____ V

3. Measure the resistance of the lightbulb with the multimeter. Set the meter on the highest resistance rating (Ω) and touch one probe to the bottom of the bulb and one to the side of the base. If the meter reads "0" (as it likely will), slowly turn the knob to lower and lower settings until the meter reads a number. _____ ohms
    (Be sure to note whether your answer is in ohms, kilo-ohms, or mega-ohms.)
4. Use Ohm's law ($V = IR$) to calculate the theoretical current through the lightbulb with both batteries connected.
    _____ amps
5. Now connect the bulb to the batteries and measure the voltage of the batteries while the bulb is lit (voltage "under load").
    _____ V
    (If your meter doesn't measure current, stop here.)
6. Your teacher will teach you how to use a multimeter to measure current. Each meter is a little different. No matter which meter you use, you must break the circuit and insert the meter into it. Record the current running through the bulb.
    _____ amps
7. Draw a schematic diagram of the circuit that you built in Step 5 using the correct schematic symbols.

Post-Lab Questions

Note: Use "Voltage under load" (while in operation) for all the voltages here.

1. Use $P = IV$ to calculate the power of the lightbulb.
    _____ W
2. Use $P = I^2R$ to calculate the power of the lightbulb.
    _____ W
3. Use $P = V^2/R$ to calculate the power of the lightbulb.
    _____ W
4. Give two reasons why your answers to the previous three questions may not be identical.

Extension

Go to the website of a battery manufacturer and look up the specifications for a battery similar to the one you're using. Using the data from this lab, figure out how long the battery would be able to power the lightbulb. You will need to find out how many milliamp-hours or watt-hours the battery can provide. If you have a battery with 10 watt-hours, it can power 10 W for 1 hr., 1 W for 10 hrs., or 5 W for 2 hrs.