Laboratory Notebook

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PHYS 122.E13

Experiment Date	Title	Page Number	Instructor Signature
5/28/24	Get a lightbulb to light	2	
5/29/24	Series Circuits & Parallel Circuits	3, 4	
5/29/24	Use of an ammeter	5, 6	
5/30/24	Does current diminish as it flows?	7	
5/30/24	Resistance	8	
5/31/24	Potentiometer	9	
5/31/24	Use of a voltmeter	10,11	

Experiment 1: Get a lightbulb to light

Equipment: 1.5-V Battery (AA battery), one lightbulb, one wire

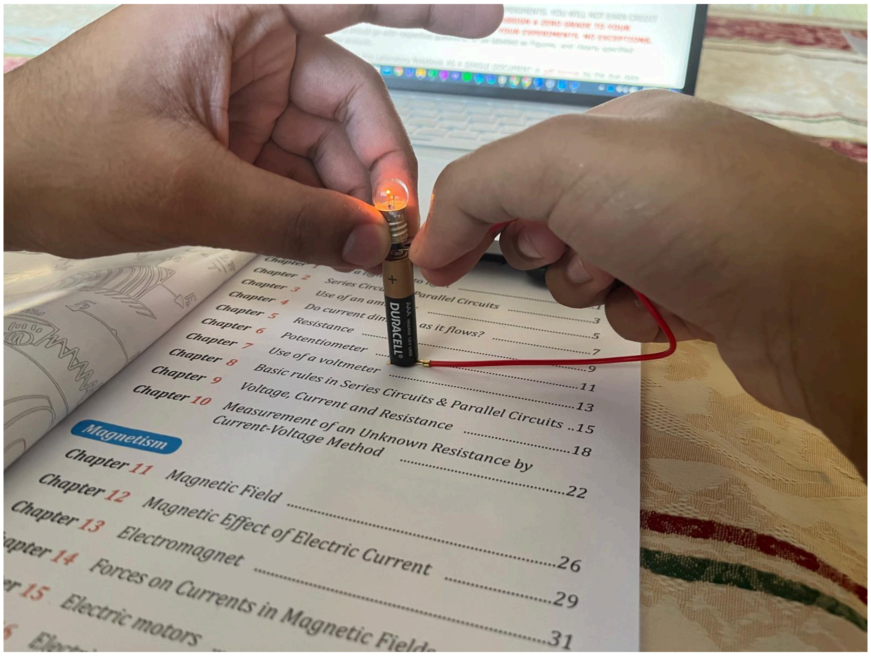

Figure 1

Data & Analytics: I knew that the electric current was flowing due to the fact that the positive terminal was connected to one end of the wire, and the negative terminal was connected to the other end of the wire. This led to the bulb lighting up, showcasing that the current was flowing. The lit bulb diagrams show a complete loop of wires, while the unlit bulb diagrams show a broken loop. As shown by Figure 1, this suggests that for the bulb to light up, there needs to be a complete loop for the electric current to flow through.

Conclusion: Any closed loop or conducting path allowing electric charges to flow is called an electric circuit. This experiment focused on the conditions that create current in an electric circuit, resulting in a product (light) being formed. It is possible to get the bulb to light with a battery, a lightbulb, and a wire. The battery supplied power, the lightbulb served as the output, and the wire facilitated electricity flow. This basic setup not only taught us about circuit fundamentals but also showcased their practical application in everyday devices. The conditions that create current in an electrical circuit involve having a closed loop or conducting path, enabling the flow of electric charges. This typically requires a power source (such as a battery), conductive materials (like wires), and a load (such as a lightbulb) that consumes the electrical energy, resulting in the formation of current within the circuit.

Experiment 2: Series Circuits & Parallel Circuits

Equipment: 1.5-V Battery (AA battery), two lightbulbs, two lightbulb sockets, some switches,, some wires

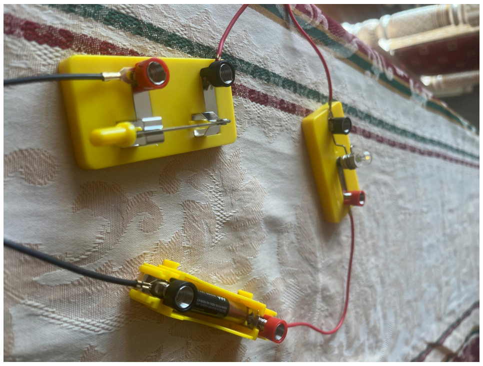

Figure 2

Data & Analytics: In Experiment A, a series circuit was constructed by connecting a lightbulb and a switch in a single path with a battery. The current flowed from the positive terminal of the battery, through the lightbulb, through the switch, and back to the negative terminal of the battery. As evidenced by Figure 2, when the switch was turned on, the circuit was complete, allowing current to flow and lighting up the bulb. Turning the switch off broke the circuit, stopping the current flow and causing the lightbulb to turn off. In Experiment B, a parallel circuit was formed by connecting two lightbulbs and two switches such that each lightbulb had its own independent path to the battery. The current flows from the battery through either Lightbulb A or Lightbulb B, depending on the state of their respective switches. When Switch A was on, Lightbulb A lit up, and when Switch B was on, Lightbulb B lit up. If both switches were on, both lightbulbs lit up, and if both switches were off, neither lightbulb lit up. This setup demonstrated the characteristics of a parallel circuit, where each branch operates independently, allowing each lightbulb to be controlled separately by its switch.

Conclusion:

A series circuit refers to a current where all the current flows through each device sequentially. In this setup, if the circuit becomes open due to the switch being turned off or the lightbulb's filament burning out, disrupting the connection, the flow of current ceases entirely. Conversely, a parallel circuit involves multiple current paths. The current from the power supply splits and flows through both lightbulbs simultaneously. When switch B is turned off in the parallel circuit, the flow of current through lightbulb B is halted, resulting in the non-operation of lightbulb B. Experiment A illustrated a series circuit, where components were connected sequentially, and current flowed through each device in a single path. When the switch was turned on, completing the circuit, the lightbulb illuminated, but when switched off, the flow of current ceased, and the lightbulb turned off. In contrast, Experiment B showcased a parallel circuit, where multiple current paths were established, allowing each lightbulb to operate independently.

Turning off switch B interrupted the flow of current through lightbulb B while leaving lightbulb A unaffected, highlighting the parallel configuration's distinct feature of independent operation.

Experiment 3: Use of an ammeter

Equipment: 1.5-V Battery (AA battery), one lightbulb, one switch, one ammeter, one lightbulb socket, some wires

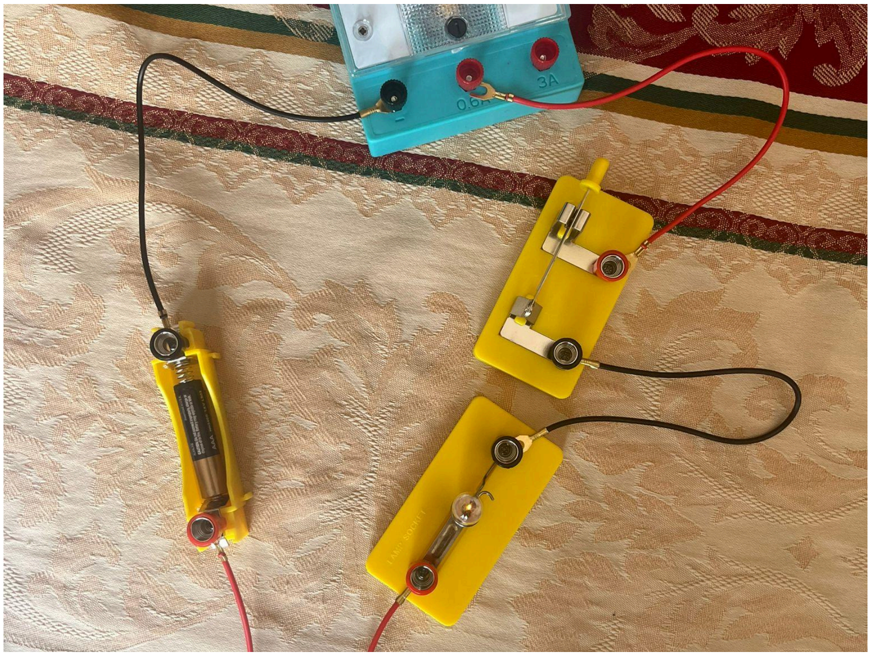

Figure 3

Data & Analytics: When connecting the 0.6A terminal, the smallest scale that can be obtained is -1. When connecting the 3A terminal, the smallest scale that can be obtained is 0. The readings for Experiment A are 1 & 0, and for Experiment B are -1 & 0. The current in both experiments are different due to the placement of the battery. I would most likely use the 0.6A range, as it allowed for more variation for the data.

Conclusion:
To measure the current in an electric circuit using an ammeter, one must first ensure that the ammeter is properly connected in series with the component whose current is to be measured. This means that the current flowing through the circuit must pass through the ammeter. Begin by turning off the power supply to the circuit and selecting the appropriate current range on the ammeter to avoid damaging the device. Connect the positive lead of the ammeter to the positive side of the power source or component and the negative lead to the negative side, ensuring secure and correct connections.

Once the ammeter is connected and the power supply is turned on, observe the needle or digital display on the ammeter. To read the current on an analog ammeter, note the position of the needle on the scale. Each mark on the scale represents a specific value, depending on the range selected. If the needle points between two marks, interpolate to estimate the current. For a digital ammeter, simply read the numerical value displayed. Always double-check the range setting to ensure that the reading corresponds accurately to the current range selected. Properly interpreting these readings is crucial for accurately assessing the current flowing through the circuit, allowing for precise measurements and analysis.

When connecting the 0.6A terminal, the smallest scale that can be obtained is -1. When connecting the 3A terminal, the smallest scale that can be obtained is 0. The readings for Experiment A are 1 and 0, and for Experiment B are -1 and 0. The current in both experiments differs due to the placement of the battery. I would most likely use the 0.6A range, as it allowed for more variation in the data.

Experiment 4: Does current diminish as it flows?

Equipment: 1.5-V Battery (AA battery), two lightbulbs, some wires, one switch, two light sockets, one ammeter

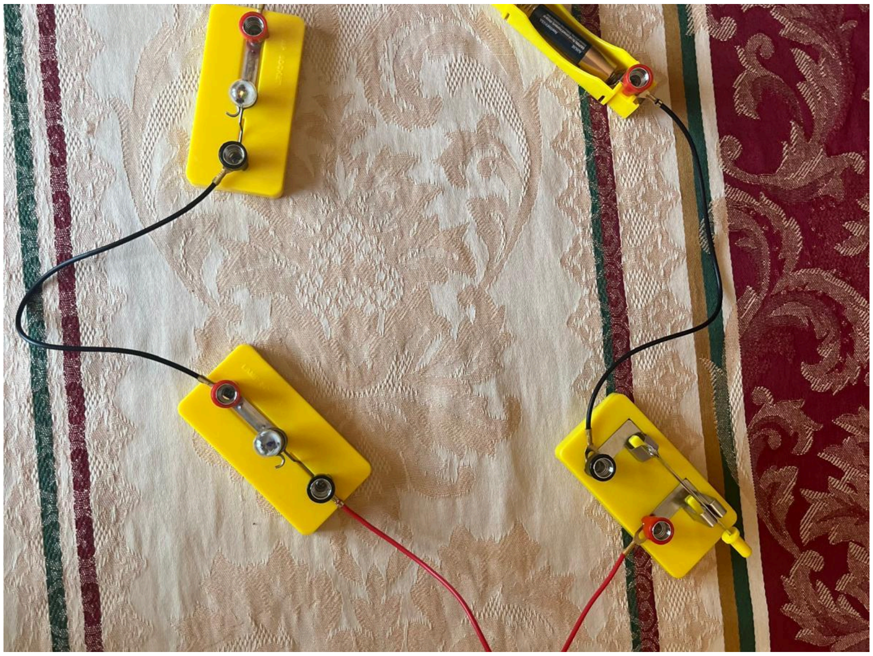

Figure 4

Data & Analytics: The current between the lightbulbs will be the same as the current before the lightbulbs. In a series circuit, the current is consistent throughout because there is only one path for the current to flow. This is confirmed in Figure 4, as it is clear that the brightness of the lightbulb are the same. That means the same amount of charge is present.

Conclusion: In a series circuit, the current remains consistent throughout the entire circuit. This means that if the lightbulbs are identical, they will have the same brightness because the same current flows through each bulb. Whether measured before, between, or after the lightbulbs, the current will be identical at all points. Consequently, the current does not decrease as it passes through different elements in the circuit. This uniformity ensures that identical lightbulbs will shine with equal brightness, as they all receive the same current.

Experiment 5: Resistance

Equipment: 1.5-V Battery (AA battery), one lightbulb, some wires, one switch, one light socket, one ammeter, 5-Ω resistor, 10-Ω resistor.

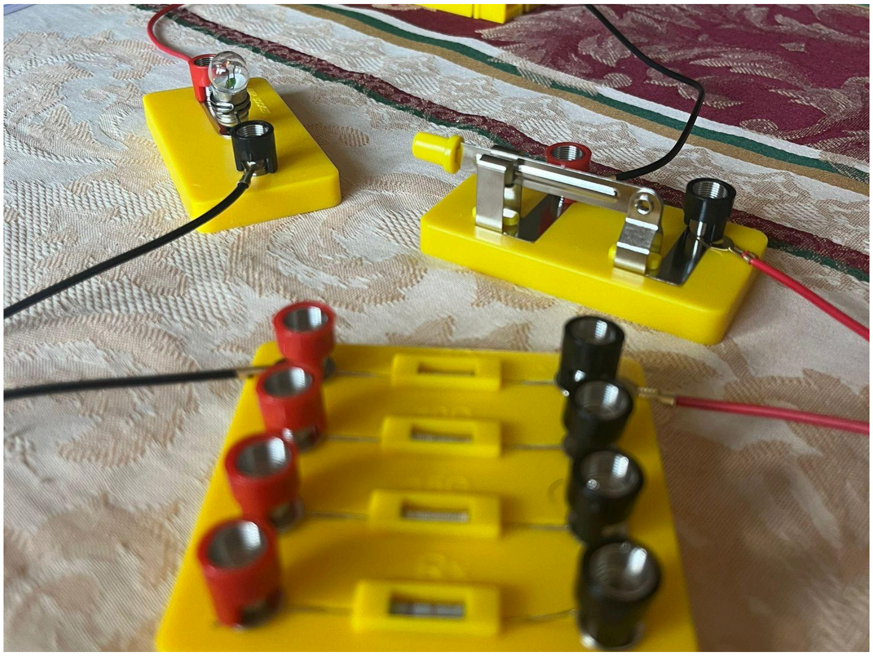

Figure 5

Data & Analytics: Through pure prediction, the lightness of the lightbulb in step 2 would most likely be more than the lightness of the lightbulb in step 3, as it is going from a 5-Ω symbol from a 10-Ω symbol, meaning that there is more resistance. This is confirmed in the trial of this using the system displayed in figure 5. This is demonstrated further, where using 5-Ω gives -0.2A, while using 10-Ω gives -0.1A, cutting it in half.

Conclusion: Resistance is a measure of how much a material opposes the flow of electric current. High resistance means that the material significantly impedes the flow of current, while low resistance indicates that the material allows current to flow more easily. When resistance increases, the current decreases if the voltage remains constant. This is because the opposition to the flow of electrons is higher, making it harder for the current to pass through. When resistance decreases, the current increases if the voltage remains constant. Lower resistance means less opposition to the flow of electrons, allowing more current to pass through. In summary, resistance opposes the flow of current in a circuit. The higher the resistance, the lower the current for a given voltage. This is present in the data that the experiment demonstrated, as it proves that the higher the resistance, the more the current is “blocked.” Going from 5-Ω to 10-Ω cuts the amps of the current by 50%, as it is by a factor of two. This proves that (at this level) it is close or at a linear progression.

Experiment 6: Potentiometer

Equipment: Two batteries, one lightbulb, one switch, one potentiometer, one ammeter, some wires

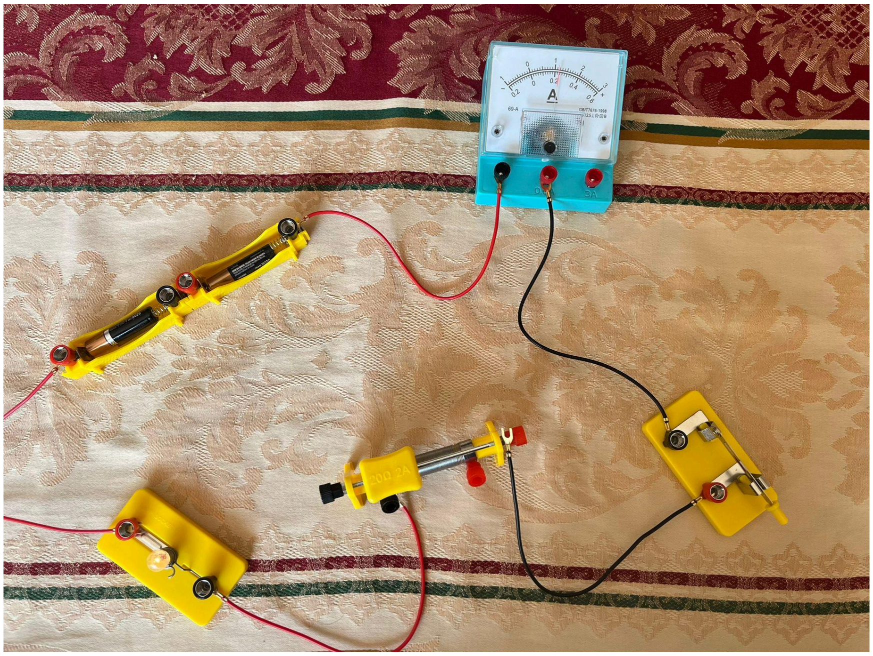

Figure 6

Data & Analytics: In the experiment, by moving the slider of the potentiometer from the left side to the right side, the charge decreased. As you move the potentiometer slide, the brightness of the lightbulb will change. The lightbulb will be dimmer when the resistance is higher and brighter when the resistance is lower. As noted in Figure 6, the slider is all the way to the left, which is when the lightbulb is the brightest. The current reading on the ammeter will decrease as the resistance increases (moving the slide one way) and increase as the resistance decreases (moving the slide the other way).

Conclusion:
A potentiometer can be used to change currents in an electric circuit by varying the length of the metal wire, which in turn changes its resistance. A resistor is a device specifically designed to provide a certain amount of resistance. As shown in Figure 6, the slider on the potentiometer can adjust the resistance, impacting the illumination of the lightbulb. This is because a potentiometer acts as a variable resistor. By adjusting the potentiometer, you alter the circuit's resistance, which affects the current flow. Different wiring configurations of the potentiometer will modify how resistance is adjusted, leading to varying brightness levels in the lightbulb and different readings on the ammeter. This experiment effectively demonstrates the interrelationship between resistance, current, and voltage in an electrical circuit.

Experiment 7: Use of a voltmeter

Equipment: Two batteries, one lightbulb, one switch one ammeter, several wires

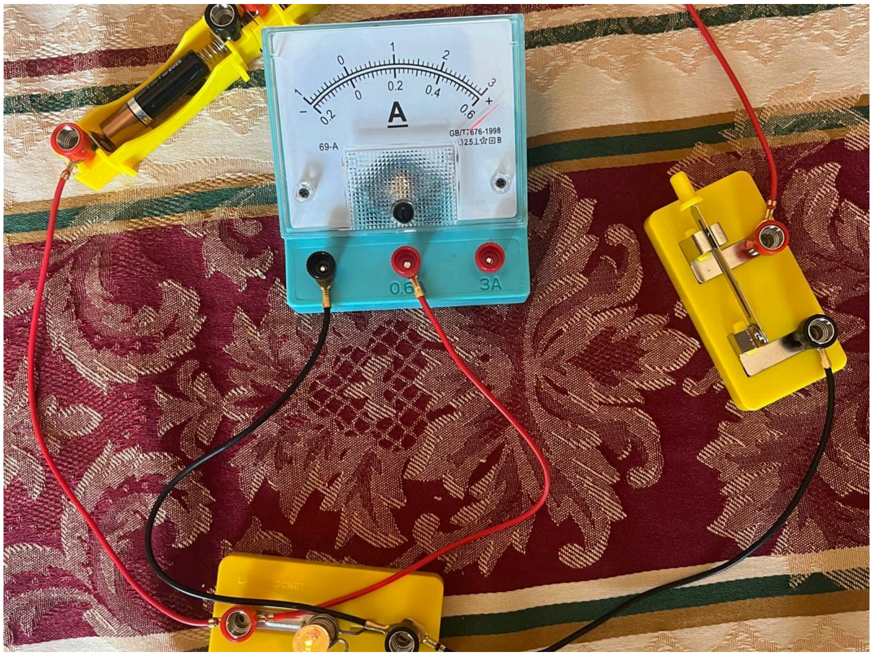

Figure 7

Data & Analytics: When using the 3A, the voltage goes to 1.6A, while when using the 0.6A, the voltage goes past 3A. By ensuring that the voltmeter is in parallel with the component whose voltage drop you are measuring, the voltmeter will show the voltage drop across the component on its display. The voltage in both experiments are not the same. To measure current, an ammeter must be connected in series with the component whose current you want to measure. This is because the current flows through the ammeter, allowing it to measure the flow of charge. To measure voltage, a voltmeter must be connected in parallel with the component across which the voltage drop is being measured. This configuration allows the voltmeter to measure the potential difference between two points.

Conclusion:
To measure the current in an electric circuit, you must open the current path and insert an ammeter in series with the component whose current you want to measure. This allows the current to flow through the ammeter, enabling it to measure the flow of charge. In contrast, to measure the voltage across a component, you connect a voltmeter across the terminals of that component. The voltmeter, which has a very high resistance, is connected in parallel with the component. This high resistance ensures that the voltmeter does not draw significant current from the circuit, preventing any alteration in the voltage being measured. It is crucial to remember that an ammeter should never be connected in parallel because its low resistance could create a short circuit, potentially damaging the circuit or the ammeter itself. A short circuit occurs when there is a low-resistance connection between two points in an electric circuit,

bypassing the intended path for the current. This can happen when the positive and negative terminals of a power supply are connected directly with a conductor of negligible resistance.