Light Bulbs and Simple Circuits

Physics 225 – Week 2 Activity

LEARNING OBJECTIVES

- Perform basic error analysis/propagation.
- Perform graphical analysis of data, including a variety of functional fits (e.g. linear, parabolic, power law).
- Measure/calculate the electrical resistance.
- Assemble electrical circuits based on a diagram, using circuit elements, power supplies, and meters.
- Write your results in the post-lab report.

BEFORE, DURING, AFTER

1. Before the experiment, read this document and finish the prelab on Blackboard.
2. During the experiment, take notes in your lab notebook.
3. After the experiment, collaborate with your team on the post-lab activity.

PRACTICE QUESTIONS

Here are questions that you will answer using this week's materials:

① How do series and parallel circuits affect lightbulb brightness?

② How can you identify lightbulbs qualitatively, using observations?

③ How can you identify lightbulbs quantitatively, using measurements?

④ Lightbulbs are often classified by power. Is power a constant property?

It's up to you to use the materials you have to answer these questions.

RESOURCES

Materials list and safety notes:
https://drive.google.com/open?id=14UfZUYhdVcXg8ke1SnIKP26_-i4F9z6W

Background information about light bulbs in series and parallel circuits:
https://drive.google.com/open?id=1Fe1btewGddhzcRAsYWvByQ6j-94ZudFk

EXPLORE QUALITATIVELY

Test the light bulbs individually and in series and parallel. Start only with the lightbulbs labeled as A and B.

If you are not confident about building a safe circuit, ask your instructor to check your setup.

Keep an eye on the voltage on the power supply readout to make sure you do not exceed maximum voltages. (Bulb A max 12 V, Bulb B max 26 V.)

❶ Test question 1. Include your observations about brightness in series and parallel circuits in your lab notebook. Include sketches of your circuits.

Test the two unknown light bulbs. One of them is the same as Bulb A, and one is the same as Bulb B.

❷ Test question 2. Can you figure out which unknown bulb is the same as Bulb A? Bulb B? Answer this question by using brightness. In your lab notebook, record which is which and why you think so. Include circuit sketches.

EXPLORE QUANTITATIVELY

Now, you will make some direct measurements and record numerical data.

With a single lightbulb and the power supply, add in a voltmeter to measure potential difference and an ammeter to measure current.

Tips: To add a voltmeter, attach the meter's leads across your object. To add an ammeter, replace a wire in your circuit with the meter and leads.

Uncertainty in a digital measurement is "1" in the last stable decimal place.

Pick two lightbulbs you think are identical based on your qualitative testing. Measure current and potential difference. Which is the dependent variable? Test both lightbulbs, and create a graph of the dependent vs. independent variable for each lightbulb. Choose an appropriate fit in Graphical Analysis.

Tip: A useful fit typically has a high correlation (-1 or 1), a low RMSE (compared to y-axis values), and error bars overlap with the curve.

❸ Compare your two graphs. Using the data, can you claim the two bulbs are identical?

Tip: Compare the fit values like slope (or equation coefficients if not linear).

❹ Use your graphs to answer question 4.

Have your instructor check your lab notebook and graphs.

DELIVERABLES

As a group, use the Lab Work Submission form to finish the post-lab activity. Save your work as a PDF file, and then submit it on Blackboard.