

Photovoltaic Cells

Part 1:

In this lab you will gather data to answer each of the four questions below (~30 minutes per question), to learn about what variables affect the power a solar cell produces.

Question 1: How does shading affect the power that a solar cell can produce?

Question 2: How does light intensity affect the power that a solar cell can produce?

Question 3: How does light angle affect the power that a solar cell can produce?

Step 1: Pre-Planning (suggested time 20 minutes)

Discuss why each question is important to a solar panel installer and if there are any physical implications for the questions and put your ideas below. In addition, determine what materials you will use for each test and where you will carry out each test (inside with flashlight or outside). If there is a material that you would like to use that is not out, ask Darby and if it is available, she will try to get it for you. **[5 pts]**

| Question | Why Important | Materials |
|--|---------------|-----------|
| How does shading affect the power that a solar cell can produce? | | |
| How does light intensity affect the power that a solar cell can produce? | | |
| How does light angle affect the power that a solar cell can produce? | | |

Make sure to use the same multimeter and solar cell for collecting all the data. Remember, power is current times voltage ($P=IV$). Measure voltage in V, current in mA, and report power in mW. Before you start your experiment, measure the size of your solar cell and take the solar cell outside and measure the electrical properties of the cell (current and voltage).

Solar Cell Size (in cm): _____ x _____

Solar Cell Electrical Properties: _____ V, _____ mA, _____ mW

Step 2: Planning/Experiment/Graph/Analysis (suggested time 30 minutes per question)

These sections should be put into word (or an equivalent program). Start with the question that is circled above. You will have ~20 minutes to complete this section for each question, then you will move to the next question on the list. For instance, if question 3 was circled you would work on the questions in the following order 3, 4, 1 and 2.

Planning: Write a procedure for the question. The procedure should be written in numbered steps and include control and changing variable values as well as what data will be collected. These procedures should allow someone that is not familiar with the lab to follow it and reproduce the data to allow them to answer the question. **[4 pts for each]**

An example short procedure is given below for testing how well detergents get grass stains out of cotton.

1. Get 3 pieces of cotton with grass stains that are 5 cm x 5 cm on them.
2. Put the cotton in the washing machine with 50 ml of A) Cheer, B) Tide, and C) All, and let it go through a normal cycle.
3. Remove the cotton and measure the size of the grass stains.

Experiment: Collect the data for the question.

Graph: Graph the data using excel. Make sure that the graphs include titles. **2.5 pts each]**

Analysis: Discuss what you found from your data (make a claim and use data to support it). Then explain what this means to someone that is interested in installing a solar panel system. **[4 pts each]**

Next class you will turn in your description of the problem (you will be graded on how well you determine why this problem is important to installers/owners), **procedures** (you will be graded on how well someone could follow this procedure), **graphs, and analysis of your data** (you will be graded on how well you use evidence to back up your claims). All materials must be typed except the description of the problem (in table on page 1).

On 5/10/24, you will make a presentation about the last question that you worked on. For a group that started with question 3 they will present on question 2. For your presentation, you will get one sheet of paper per group where you can put a graph as well as up to 4 concluding sentences (see example on right). **Bring 7 copies of this to class; failure to do so will result in -5 points.** The class will vote on which group they think designed the best experiment, had the most reliable data, and had the best data to back up their claim. For each question, there will be 1 winner and that group will get 3.5 points.

Part 2:

The next class meeting after the presentations, you will need to turn in your typed answers to three of the questions below. You will not answer the question about the topic that your group presented on. **[4 each]**

Which group had the best procedure and conclusion about the effects of shading on solar cells?
And Why?

Which group had the best procedure and conclusion about the effects of light intensity on solar cells?
And Why?

Which group had the best procedure and conclusion about the effects of light angle on solar cells?
And Why?

Assuming the insolation of the sun is $175 \frac{W}{m^2}$ what is the efficiency of your solar cell? (Use the data that you took before starting your tests.) **[2 pts]**



Graph

Your conclusion from your experiment and what this means for someone installing solar panels. This can be no longer than 4 sentences.