LAB 1 Laboratory Activity

Solar Cells

The Sun's radiant energy drives the weather and water cycles of Earth. This energy is necessary to sustain life on Earth. It might also be powering your pocket calculator or providing the hot water for your next shower.

Many pocket calculators contain solar cells. A solar cell is a device that converts radiant energy into electrical energy. In a circuit, a solar cell can produce an electric current. In this experiment you will investigate the power output of solar cells.

Strategy

You will determine the power of output of a solar cell.

You will describe how the power output of a solar cell is related to the power rating of its energy source.

You will compare sunlight and artificial sources of radiant energy.

Materials

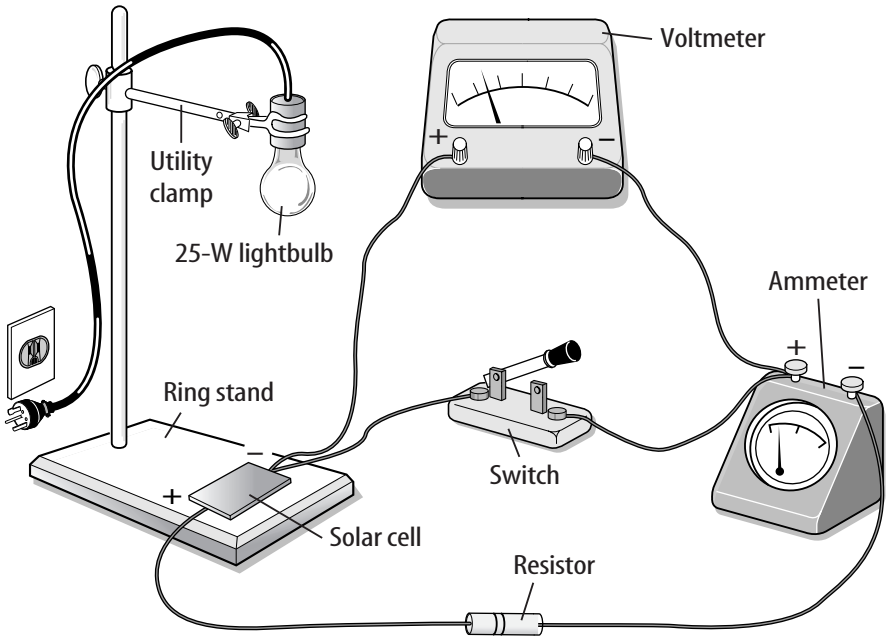
25-, 60-, 75-, and 100-W lightbulbs
10-cm lengths of insulated wire (4)
light socket and cord
utility clamp
ring stand
meterstick
masking tape
solar cell
DC voltmeter
DC ammeter
resistor switch

Procedure

Part A—Artificial Sources of Light

1. Place the 25-W lightbulb into the light socket.
2. Attach the utility clamp to the ring stand. Use the utility clamp to position the light socket so that the bulb is 50 cm above the desk top. **CAUTION:** *Tape the socket's electrical cord onto the desk top so that no one can trip over the cord or topple the ring stand.*
3. Place the solar cell parallel to the desk and directly beneath the bulb.
4. Connect the voltmeter, ammeter, switch, and solar cell with the insulated wires as shown in Figure 1.
5. Plug the socket cord into an electrical outlet. Darken the room.

Figure 1



Laboratory Activity 1 (continued)

6. Switch on the 25-W bulb. Close the switch in the circuit. Measure the potential difference and the current with the voltmeter and ammeter, respectively. Record the value of the power rating of the bulb, the potential difference, and current in Table 1.
7. Open the circuit switch. Turn off the bulb and allow it to cool. **CAUTION:** *Lightbulbs generate heat. Do not touch the lightbulb for several minutes.*
8. Remove the lightbulb and replace it with the 60-W bulb.
9. Repeat steps 6–8 for the 60-W, 75-W, and 100-W lightbulbs.

Part B—Sunlight

1. Move the circuit containing the solar cell, voltmeter, ammeter, and switch to a sunny location, such as a window sill. Position the solar cell perpendicular to the sunlight.
2. Close the circuit switch. Measure the potential difference and the current with the voltmeter and ammeter, respectively. Record these values in Table 2. Open the switch.

Analysis

1. The power output (P) of the solar cell can be calculated using the following equation.

$$P = V \times I$$

In this equation V represents the potential difference measured in volts (V) and I represents the current measured in amperes (A). The unit of power is the watt (W). Use this equation to calculate the power output of the solar cell for each lightbulb. Record in Table 3 the value of the power rating of the lightbulb and the power output of the solar cell for each lightbulb.
2. Use Graph 1 to plot the power rating of the lightbulbs and the power output of the solar cell. Determine which variable should be represented by each axis.
3. Calculate the power output of the solar cell from Part B of the procedure. Record the value in Table 2.
4. Use Graph 1 to estimate the power rating of sunlight. Record the value in Table 2.

Data and Observations

Table 1

Lightbulb	Solar cell	
Power rating (W)	Potential difference (V)	Current (A)

Table 2

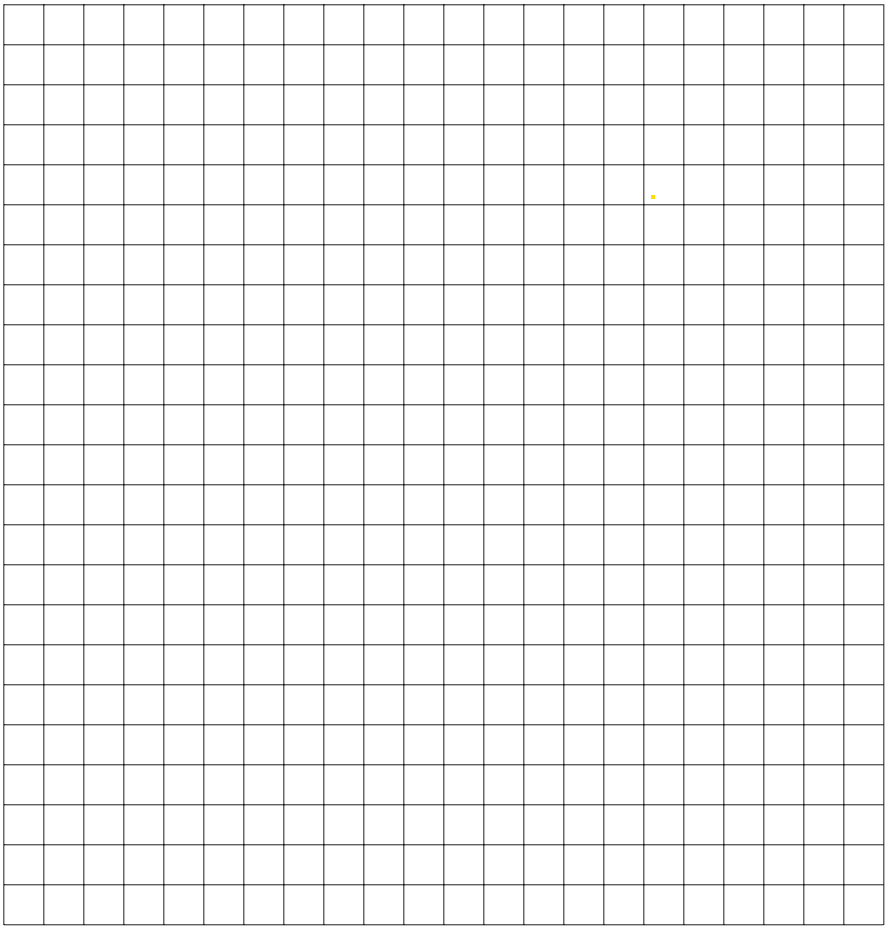
Solar cell			Sunlight
Potential difference (V)	Current (A)	Power output (W)	Power rating (W)

Laboratory Activity 1 (continued)

Table 3

Lightbulb	Solar cell
Power rating (W)	Power output (W)

Graph 1



Laboratory Activity 1 (continued)

Questions and Conclusions

1. Which lightbulb produced the greatest power output of the solar cell?

2. How is the power output of the solar cell related to the power rating of the lightbulbs?

3. How does sunlight compare to artificial sources of light?

4. How many solar cells operating in sunlight would you need to power a 100-W lightbulb?

Strategy Check

_____ Can you determine the power output of a solar cell and relate it to the power rating of the energy source?

_____ Can you compare sunlight and artificial sources of radiant energy?