# Angle and Output

1. Turn to page 1 on your worksheet.
2. Connect the wire leads from the solar panel to the multimeter cables. **Be sure that red is attached to red and black is attached to black.**
3. Turn the multimeter knob to the left to select voltage range 20 V.
4. Attach the flashlight to the ruler using the Velcro. The flashlight should shine towards the center of the ruler.
5. Turn on your flashlight.
6. Place the protractor along the side of the solar panel with the colored tape **(see image)**. The Velcro on the protractor should be facing away from the solar panel.
7. Attach the ruler and flashlight to the protractor with the Velcro so you can read 90° on the protractor through the ruler. At this angle, the flashlight will illuminate the solar panel.
8. Record the voltage to the nearest 0.01V in the *Angle and Output Data* table on your worksheet.
9. Detach the ruler and pivot it to the left until you read 60° through the center of the ruler. Attach the small piece of Velcro on the ruler to the small piece of Velcro on the protractor. Keep the ruler and protractor flat against the table surface.
10. Be sure the flashlight illuminates the solar panel. Record the voltage for 60°.
11. Repeat steps 9 and 10 for 40° and 20°.
12. Turn off the flashlight and multimeter. Disconnect the leads and Velcro.
13. Graph your data on *Graph: Angle and Output.* Note: you will plot your data points from right to left.
14. Answer question 1 at the bottom of page 1.

# Temperature and Output

1. Turn to page 2 on your worksheet.
2. Connect the wire leads from the solar panel to the multimeter cables. **Be sure that red is attached to red and black is attached to black.**
3. Turn the multimeter knob to the left to select voltage range 20 V.
4. Place the flashlight on top of the container with the solar panel **(see image)**.
5. Insert the thermometer in the hole on top of the container. Turn on the thermometer and be sure it is reading in °C.
6. Turn on the flashlight. The flashlight should be illuminating some parts of the solar panel.
7. Record the room temperature and voltage in the *Temperature and Output* table on your worksheet.
8. Use the beaker to measure 300 mL of warm water and pour it into the pie pan that is sitting on the towel.
9. Carefully place the clear container and solar panel into the pie pan, being sure that the wires do not go near the water.
10. Place the flashlight back on top of the container over the solar panel.
11. Using the stopwatch, record the temperature and voltage every 30 seconds for 4 minutes.
12. After 4 minutes, turn off the thermometer, flashlight, and multimeter. Remove the clear container from the water and set it on the towel. Disconnect wire leads from the multimeter. Pour out the water. Remove the thermometer. Open the lid of the container to air it out for the next group.