

Fuels, nuclear power, renewables and the climate

Grade 8 science (Year 9 · Class 8) · Lab

Name: _____ Date: _____ Class: _____

How much does the angle of a solar cell matter? In this lab you tilt a small solar cell away from a lamp, measure the voltage across a fixed resistor, calculate the power and decide how a real roof panel should be placed.

Level: Grade 8 science (Year 9 · Class 8) · **Curriculum:** MS-ESS3-3

Aim

To investigate how the angle between a solar cell and a lamp changes the electrical power produced.

Equipment

- Small solar cell on a hinged stand
- LED desk lamp
- 20 Ω resistor
- Digital voltmeter
- Protractor, ruler and connecting leads

Safety

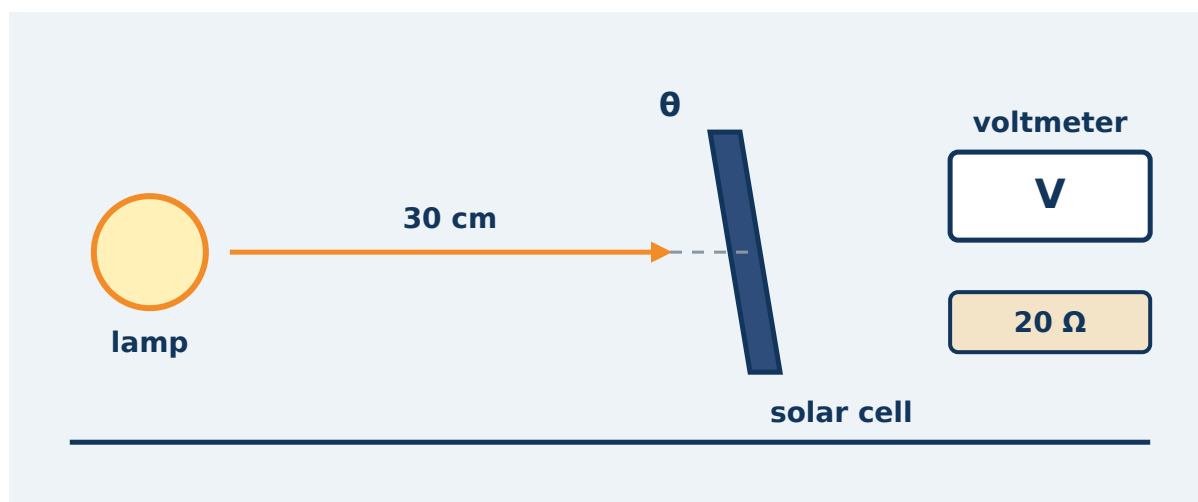
Safety

Keep water away from the electrical equipment. Do not look directly into the bright lamp. Use only the low-voltage cell and a lamp that has been checked, and switch off when changing the circuit.

Method

1. Connect the solar cell, the 20 Ω resistor and the voltmeter across the resistor.
2. Place the lamp 30 cm from the cell so that the cell faces the lamp directly. Call this angle $\theta = 0^\circ$.
3. Darken the room, switch on the lamp and read the voltage.
4. Tilt the cell away from the lamp by 20° , keeping the distance the same, and read the voltage again.

5. Repeat for 40°, 60°, 70° and 80°.



θ is measured from the position where the cell faces the lamp directly. The lamp distance stays at 30 cm.

Results

Sample measurements from a school lab. The power in the resistor is calculated from $V^2 \div R$.

Angle θ (°)	Voltage V (V)	Power $P = V^2 \div 20$ (W)	$P \div P$ at 0°
0	1.80	0.162	1.00
20	1.74	0.151	0.93
40	1.58	0.125	0.77
60	1.27	0.081	0.50
70	1.05	0.055	0.34
80	0.75	0.028	0.17

Analysis questions

Question 1 Check the first power

Show that the power at $\theta = 0^\circ$ is 0.162 W.

Question 2 Power at 40 degrees

Calculate the power in the resistor at $\theta = 40^\circ$ when $V = 1.58$ V.

Question 3 Percentage of the maximum

Calculate the power at 60° as a percentage of the power at 0° .

Question 4 Describing the pattern

Describe how the power changes as the angle increases.

Question 5 Graph

Describe the graph of power against angle and say what it predicts at 90°.

Question 6 Real panels

Explain why solar panels on a roof are tilted towards the Sun.

Question 7 Uncertainty

The voltmeter reading is uncertain by ± 0.02 V. Calculate the percentage uncertainty in V at 80° and in P.

Question 8 Improving the investigation

Suggest two ways to improve the reliability of the results.