



ENERGY AND THE ENVIRONMENT

Photovoltaic Cells

Take-Home Experiment Write-Up

In order to find the peak power output from the photo cell and the resistance at which this occurs, the circuit is connected as shown below:

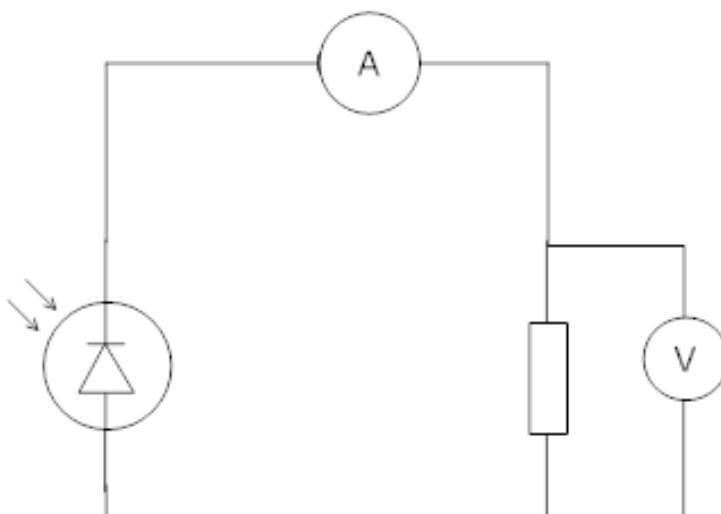


Figure 1: Circuit Diagram Showing Experimental Set Up

KEY:



Photocell



Ammeter



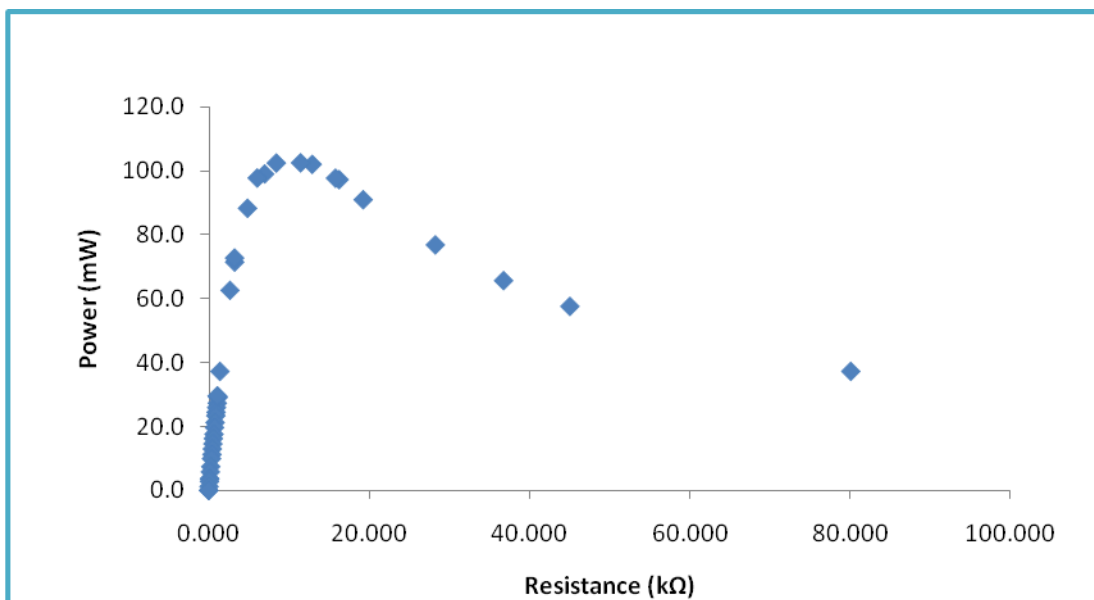
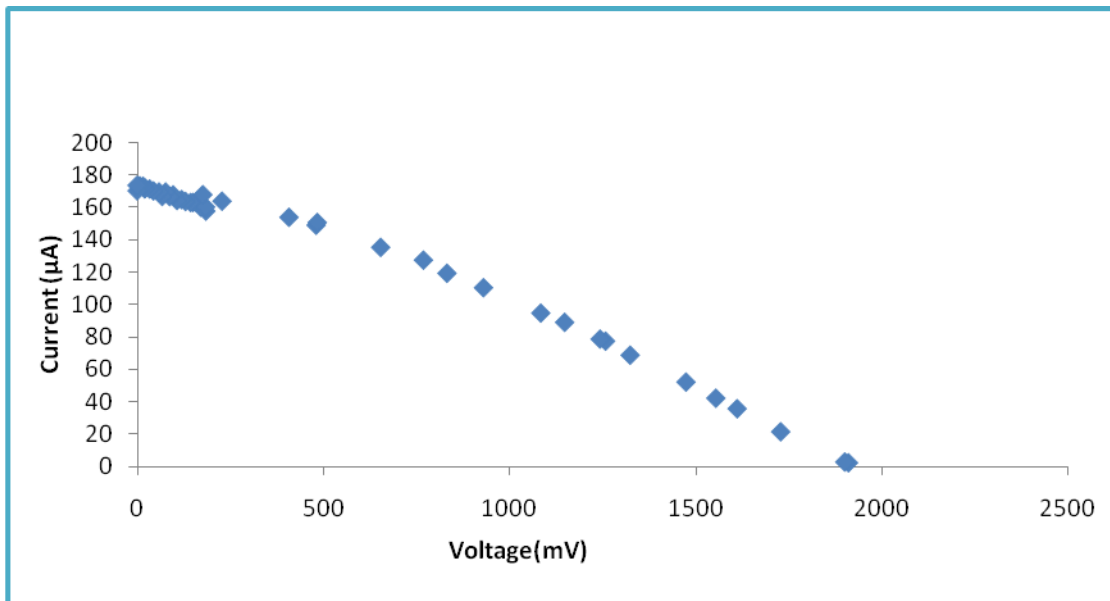
Voltmeter



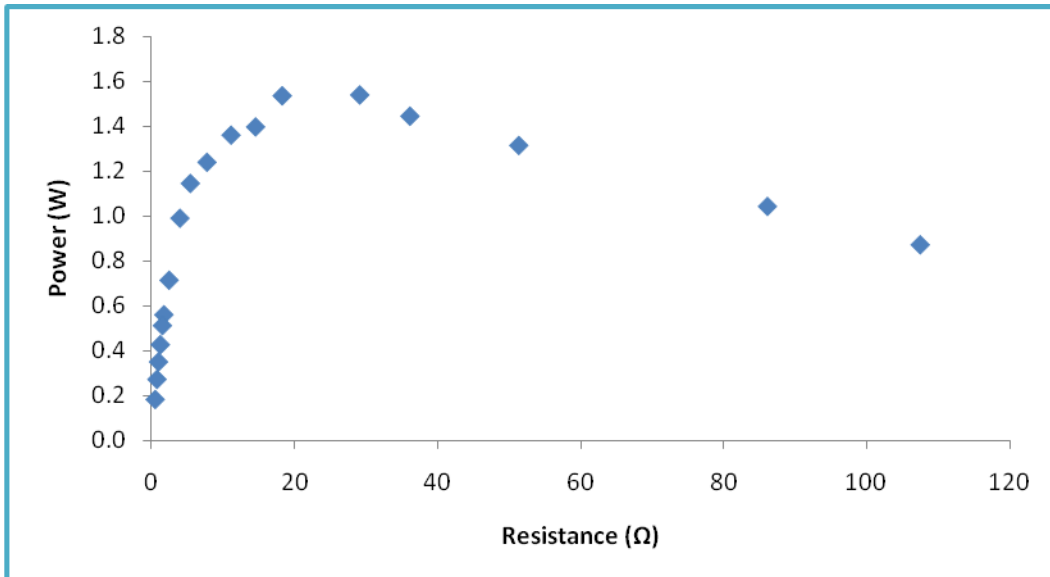
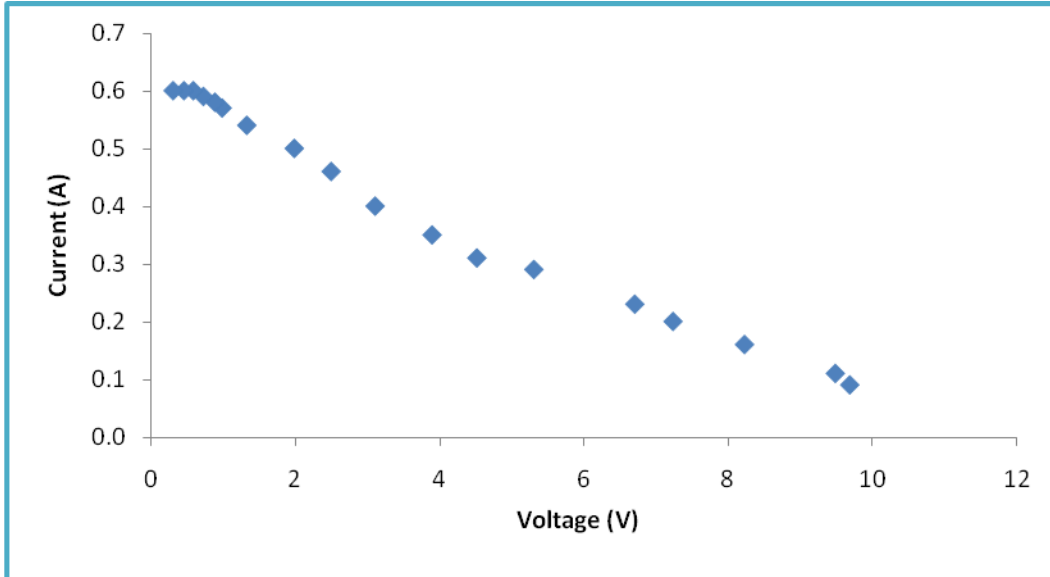
Resistor

Three different variable resistors are used: a $100\text{k}\Omega$, a 1300Ω and a $5\text{M}\Omega$ resistor. For each resistor, the voltage and current readings are measured, both indoors and outdoors in the direct sunlight on a clear day. These values of voltage and current are recorded, from which the corresponding resistance and power output are calculated. Finally, by graphing the power vs resistance, the resistance at which optimum power is yielded is seen.

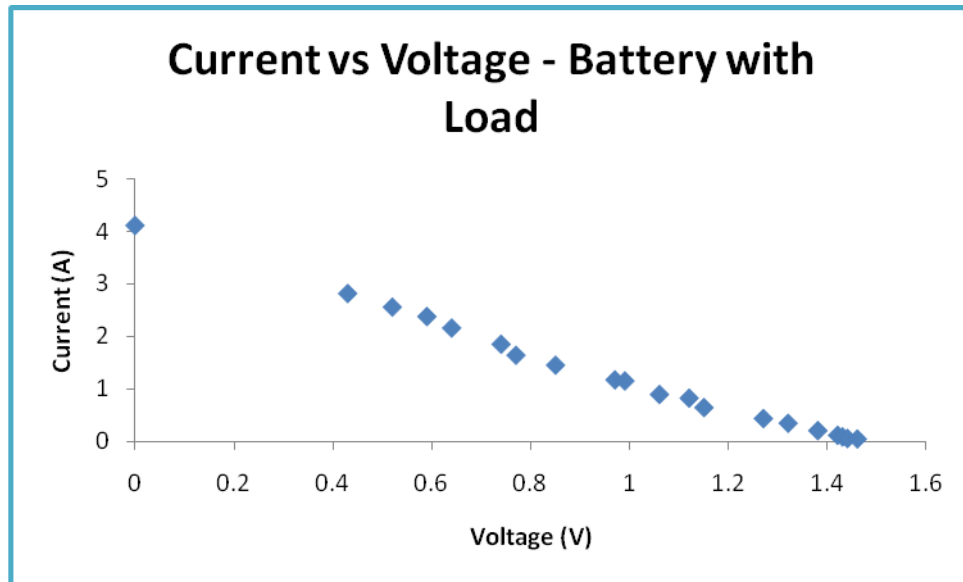
PHOTOCELL - INDOORS



PHOTOCELL - OUTDOORS



Compare the current vs voltage graphs of a photocell, to that of a battery with a load:



Notice how the photocell graphs have an initial flat region, where the current doesn't change much with a change in the voltage. For the circuit containing a battery and load however, the graph has a constant downward slope.

Calculations:

1. Resistance

The resistance is calculated using the relationship defined by ohm's law:

$$R = \frac{V}{I}$$

Example: $R = \frac{0.980 \text{ V}}{0.570 \text{ A}} = 1.719 \Omega$

2. Power

The power is calculated using the following formula:

$$P = VI$$

Example: $P = (0.980 \text{ V})(0.570 \text{ A}) = 0.559 \text{ W}$

Results:

Indoors, the peak power output was 102.7 mW, at a resistance of 11.45 k Ω

Outdoors, the peak power output was 1.541 W at a resistance of 29.13 Ω

There is a noticeably large difference between the maximum power obtained indoors and that obtained outdoors - the power available under a cloudy sky is 15 times greater than even a well lit room. This is because the outdoors, even on a cloudy day, is brighter than the brightest room. Furthermore, the optimal load resistance is very different in the two cases, so any serious attempt to generate power needs to be able to adjust this load to the ambient light conditions

Anoushka Rajan 2010/05/13