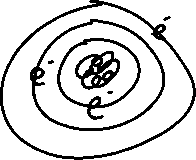
**Solar Cells and Light Energy Conversion to Electrical Energy**

In 1839 a French Physicist, Edmund Bequerel, noticed that some materials under bright light exhibited a small voltage.



In 1905, Albert Einstein’s Nobel prize winning work on the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ described the nature of light and how electrons can absorb energy.



Energized electrons can become more \_\_\_\_\_\_\_\_\_\_\_\_\_\_ causing the resistivity of the material to drop. An example is a CdS Light Sensitive Resistor (LSR) also called a photoresistor.



The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_ \_\_\_\_\_\_\_\_\_\_\_\_ means that energy is \_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ but energy can \_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_ from one \_\_\_\_\_\_\_\_\_\_ to another.



Photovoltaic cells = Solar cells

See the Power Point lecture from Ohio State on Blackboard.

Solar cells are typically made of \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ and are an energy conversion device.



Silicon is “doped” using other atoms than silicon to create \_\_\_\_\_ and \_\_\_\_\_\_ type semiconductors.



\_\_\_\_\_\_ type has more free electrons than pure silicon.



\_\_\_\_\_\_ type has more free positive charges than pure silicon.



n type Light Bulb

p type

The outer surfaces have electrodes attached which allows current flow through a circuit.

An outer protective clear layer with an antireflective coating protects the cell.

\_\_\_\_\_\_\_\_\_\_\_\_\_ is a widely used concept in energy conversion.



% efficiency = output \* 100 Lab Lamp

input



% efficiency =



Solar cell



Resistor



Circuit



The \_\_\_\_\_\_\_\_\_\_\_ of the solar cell matters greatly in efficiency calculations.



e I A = Psc  e = efficiency (decimal value not %)



I = Intensity of incident light units: W/m2

A = Area of the solar cell units: m2

Psc = Electrical Power output of the solar cell P=ΔV2/R units: W

The efficiency = e = Psc = output

IA input



Example Problem 1: You have a 0.8 m by 1.6 m solar panel that is 11% efficient. On a bright sunny day the intensity of the sunlight on the solar cell is 1080 W/m2. How much power can this solar cell produce?



eIAHday = Eday Hday = Hours/day the sun is shining

Eday = Energy/day the solar cell is producing



Example Problem 2: For the cell in problem #1, if the sun is shining brightly for 12 hours each day, how much energy does it produce per day?



Solar cells generate \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_ in a circuit. (Abbreviated \_\_\_\_\_.)



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_is commonly used in most home and industrial applications. (Abbreviated \_\_\_\_\_)



For many applications of solar generated power, the electricity undergoes a secondary \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ step to convert it to \_\_\_\_\_\_\_ so that it is compatible to common devices.



**Light intensity measurement in solar meter lab**:



The output of the solar meter (silicon photovoltaic device) is a \_\_\_\_\_\_\_\_ that is measured by the binary \_\_\_\_\_\_\_\_\_\_\_\_\_. \_\_\_\_\_\_\_ lights to give a reading from the binary voltmeter. To utilize the binary meter, the base 2 (binary) output must be converted to base 10 decimal readings. LED’s **O**OO**O O**OO**O** Lighted = O



A binary LED output would be read as: Not lighted = **O**



**Conversion of binary numbers to base 10 decimal numbers**

Sample Problem #3 Convert the binary number 0110 0110 to a base 10 decimal number.



In the solar cell lab, this number can be converted to light intensity:



**Conversion of base 10 decimal numbers to binary numbers**

Sample problem # 4. Suppose you have a common decimal number 180, what would this be in binary?

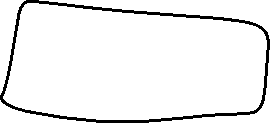


Review efficiency calculations

Sample problem #5. If Iron Man had solar cells mounted on the back of his suit, would the cells be efficient enough to supply the power needs of his suit? Assume the area of the back of his suit is 1.6 m2. It is a typical day of crime fighting and saving the world when the sun is shining with an intensity of 1100 W/m2. The cells are 30 % efficient.



Hint: A light bulb is commonly about 40 W and a hair dryer is about 1000 W.



Sample Problem #6. You are considering solar panels for your home. Your sunny area on your roof is about 92 m2. A little research shows Columbus has about an average of 4.15 hours of peak sun a day where the light intensity is above 1000 W/m2. The energy use per day of a typical home is about 30kWh per day. The salesman says you have enough roof area to generally support your power needs. If typical solar cells are about 12% efficient, is the salesman correct?

