Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_ Period: \_\_\_\_\_\_\_

**Section 1**: **System Design**

For this activity, you and your group are to attempt to design a wiring diagram for a solar battery charger. The battery is a 12 V, 35 Ah lead-acid battery. The materials you are able to include in your diagram are shown in the list below:

* 1 spool of black wire
* 1 spool of red wire
* 15 x 3V, 1A solar modules (with alligator clip connectors)

1. Consider the power and energy rating for the battery. Calculate the number of Watt-hours (Wh) of energy the battery can potentially store.
2. How long would you be able to power a 100 W lightbulb with this much energy?
3. A 100 W equivalent compact fluorescent lightbulb (CFL) requires just 26 W of power. How long should the battery be able to power this lightbulb?
4. A 100 W equivalent LED require just 16.5 W of power. How long could you power this bulb?
5. Work with your group to brainstorm ideas for your wiring diagram. Your diagram must include color and labels indicating where series or parallel wiring occur, along with calculations to illustrate the total voltage, amperage, and watts of your system. Use the space below to produce rough drafts of your ideas. Your final product needs to be drawn on a separate sheet of paper. Be prepared to share your diagrams with the rest of the class.

**Section 2: Predict and Test**

Now it’s time to test the design we chose. Between 9:00 AM and 3:00 PM we should be able to get about 6 hours of good sunlight. You will record the Watt’s-Up meter reading several times throughout the day today.

1. Using the power output of the solar modules, predict the amount of energy we should be able to store in the battery throughout the day today. Show your work.
2. How long would it take our system to fully charge the battery if it were completely depleted?

**Data Collection:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Time | Volts | Amps | Amp hours (Ah) | Watt hours (Wh) |
| 9:00 AM |  |  | 0 | 0 |
| 10:00 AM |  |  |  |  |
| 11:00 AM |  |  |  |  |
| 12:00 PM |  |  |  |  |
| 1:00 PM |  |  |  |  |
| 2:00 PM |  |  |  |  |
| 3:00 PM |  |  |  |  |

1. Write a conclusion for this experiment, which addresses the accuracy of your predictions using the “Claim, Evidence, Reason” format. You must include actual data points as evidence.

**Section 3: Predict and Test (part II)**

Now that we have charged the battery some, let’s predict the amount of time the battery will be able to power an appliance. Options available for testing include:

* 2 x 100 Watt lamps
* Hairdryer
* 5000 BTU air conditioner
* Space heater

Now let’s vote on what we would like to test!

1. Once we have selected which we would like to test, make a prediction by calculating the theoretical amount of time we should be able to power the appliance based on the energy reading we took yesterday.
2. How long were we actually able to power the appliance? What are some possible reasons for the difference between your prediction and the actual value?
3. The battery we tested stores about 420 Wh of energy. The mid-range Tesla Model S stores about 75 KWh of energy. Is the system we tested at all practical for charging a battery like that of the Tesla vehicle? Why or why not?