LEAD STORAGE BATTERIES

LAB COMP.34

Two or more wet or dry cells connected make a battery. A car battery is generally a lead storage battery, containing lead and lead oxide plates in sulfuric acid solution. In this experiment, you will build a lead storage cell and use the interface box to charge it. You will use a computer to measure the cell's voltage, and use the cell to power an electric motor.

OBJECTIVES

In this experiment, you will

- build a lead storage cell
- use an interface box to charge the cell
- measure the cell's voltage before and after use
- use the charged cell to power an electric motor
- make conclusions using the results of the experiment

MATERIALS

TI 83$^+$ Silber with Datamate
4 D batteries and holder
Vernier Voltage Probe
2 lead strips (2 cm x 12 cm)
6 test leads with alligator clips

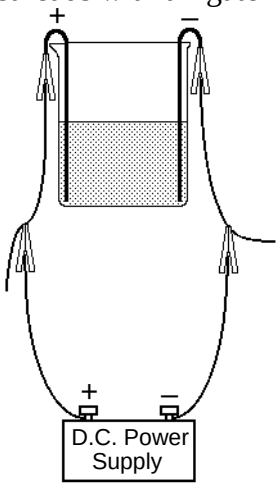

Figure 1

250-mL beaker
sulfuric acid, H_2SO_4 (1.0M)
clock (with second hand)
small electric motor/generator
multimeter

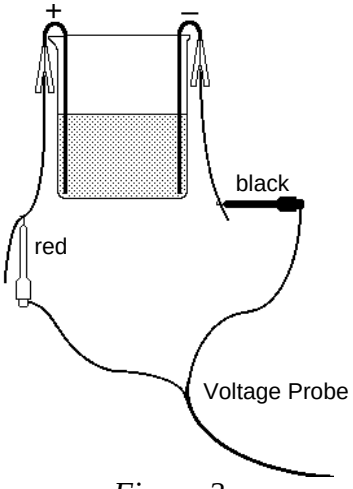

Figure 2

PROCEDURE

1. Obtain and wear goggles and an apron. **CAUTION:** The battery acid, H_2SO_4, used in this experiment can damage eyesight and make holes in clothing!

2. Get two lead strips. If the strips have been used before, get one labeled (+) and one labeled
(–). If the strips are not marked, label one (+) and the other (–). Bend the strips and place them in a 250-mL beaker as shown in Figure 1. Attach an alligator clip to each lead strip.

3. Add 125 mL of sulfuric acid (H_2SO_4) to the beaker. Be very careful with this "battery acid"!

4. Prepare the calculator for data collection by starting the datamate program with the voltage probes in Channel 1.

5. Charge the cell using the direct-current power supply:

   a. Attach the (–) lead from the power supply to the alligator clip on the cell's (–) Pb electrode, as shown in Figure 1.
   b. Attach the (+) lead of the power supply to the alligator clip on the cell's (+) Pb electrode to begin the charging process.
   c. Time the charging process and disconnect the power supply leads after 4 minutes. Make and record observations during the charging process. **CAUTION:** *Make sure the lead strips do not touch each other during charging. Do not breathe the vapors produced during the charging process!*

6. Attach the Voltage Probe's *red clip* to the alligator clip on the (+) electrode (the black clip should still be attached to the (–) electrode via an alligator clip). Read the voltage value displayed in the window above the graph. Record the reading after it stabilizes.

7. Disconnect the black and red Voltage Probe clips from the cell. Use two wire leads to connect the cell to a small electric motor. Use a clock to measure the number of seconds the charged cell runs the motor. Record the results. The cell is said to be *discharging* during this process.

8. Attach the Voltage Probe's *red clip* to the alligator clip on the (+) electrode and its *black clip* to the alligator clip on the (–) electrode. Measure the voltage of the *discharged* cell. Record this value.

9. Repeat Steps 5-8 using a 2-minute charging time.

10. Observe the two lead electrodes and record your observations.

11. Return the H_2SO_4 solution to the "Used H_2SO_4" container supplied by your teacher. Wash and dry the beaker and the lead strips.

12. Join with two other lab groups, connect your three cells, once in series and then in parallel, and measure the voltage produced by your battery.

13. Use multimeter to measure the current produced.

OBSERVATIONS

DATA TABLE

	1st Charging	2nd Charging
Voltage after charging (V)	_____	_____
Time motor ran after charging (s)	_____	_____
Voltage after discharge (V)	_____	_____

	Series	Parallel
Voltage of battery	_____	_____
Current of battery	_____	_____

PROCESSING THE DATA

1. Add the voltage after the first charging and the voltage after the second charging and then divide by 2 to calculate the average voltage of your cell when charged.

2. Cars generally have 12-volt batteries. How many lead storage cells, similar to the one you built, does a car battery contain? Explain.

3. How was the electrical energy used to power the electric motor produced?

4. The bubbles you saw produced during charging contained hydrogen gas. Why is there danger of an explosion during and after car battery charging?

5. Look up chemical equations for the charging and discharging reactions studies in this experiment. What was the substance that formed on the (+) strip during charging? Explain why "run-down" car batteries sometimes freeze up and break open in extremely cold weather.

6. Summarize what you have learned during this experiment.