Lab Making An Activity Series of Metals

The oxidation state of an uncombined atom is zero. The ease with which this oxidation state is changed by giving up electrons indicates the relative activity of the atoms of this element. Compare the oxidation numbers of sodium and hydrogen on the left side of the equation (reactants) to that of the sodium and hydrogen on the right side of the equation (products) in the following equation:

$$2\overset{0}{N}a \;+\; \overset{+1}{H}_2\overset{-2}{O} \;\rightarrow\; \overset{+1}{N}a_2\overset{-2}{O} \;+\; \overset{0}{H}_2$$

Notice that the oxidation numbers of sodium and hydrogen have changed. In its free state sodium has an oxidation number of 0. As the chemical reaction takes place, sodium gives up an electron to hydrogen in the water molecule causing the sodium to change its oxidation number from 0 to +1 as seen in the sodium oxide formula. Since sodium gives up its electron more easily than hydrogen, sodium is considered a more active element than hydrogen.

Observing spontaneous reactions such as that symbolized in this equation, scientists can devise a list of elements in their order of activity. Using such a list can help one predict whether a chemical reaction will take place or not take place.

In this experiment you will examine several chemical reactions. From your observations you will construct a list of 6 metals in their order of activity beginning with the most active metal down to the least active metal.

MATERIALS

1 Reaction plates (24-well)
1 Beral pipets (thin-stem/short)
1 Steel wool pad (fine) or piece of sand paper
1 Q-tip or cotton ball
1 Lead pencil refill (3 cm in length) or carbon rod
1 Multi-meter (0.5 mA setting)

CHEMICALS

10 ml Hydrochloric acid (0.1 N)
Metal strips (0.5 x 4 cm)
1 Copper
1 Iron
1 Magnesium
1 Lead
1 Tin
1 Zinc

PROCEDURE

1. Setting Up the Apparatus

Note: *Before setting up* the apparatus, *be sure* that all of the metal strips given to you are cleaned of any metal oxide.

Using a 24-well reaction plate (see Fig. 1), place about 50 drops of hydrochloric acid into each of the following wells: A1 and A2.

To make the salt bridge, use the cotton from 1 end of a Q-tip and place it across the wells as shown in Figure 1. Make sure the cotton becomes saturated with the acid solution.

Next, connect 1 end of a wire to the piece of **carbon rod** (**reference electrode**) and the other end of the wire to the ***positive side*** of the multi-meter. Now place the reference electrode into well A2 which contains the acid (see Fig. 1).

Using a second wire, in a similar manner connect 1 end of this wire to a strip of copper **metal** and the other end of the wire to the ***negative side*** of the multi-meter (see Fig. 1). Now place the copper strip into well A1 which contains the acid.

Finally, check that both wells are almost completely filled with hydrochloric acid; if not, add more acid to the well(s).

2. Measuring the Activity of Various Metal Elements

Turn the dial of the multi-meter to the position which will read 1.0 mA. If there is a setting of 0.5 mA, set the dial to this position.

Wait 2 minutes in order to allow the meter to stabilize, then RECORD your measurement in milliampheres (mA).

Now turn the dial to the *OFF position* and replace the copper strip of metal with another metal. *Repeat this process* with each of the metal strips given to you. Be sure to check that both wells are almost completely filled with hydrochloric acid; if not, add more acid to the well(s).

3. Listing the Order of Activity

Using your experimental data, list the metals in their order of activity *beginning with the most active* and ending with the least active.

Using the class averages, make a similar list of the activity.

Lab Making An Activity Series of Metals

NAME _____Date _____Period ____

QUESTIONS

1. What element would you consider to be the most active?
2. Why?
3. What element would you consider to be the least active?
4. Why?
5. Using your data, which element is more active, copper or zinc?
6. Using your data, which element has the greater tendency to retain electrons, copper or zinc?
7. Why?
8. Using your data, which element is more active, copper or hydrogen?
9. Why?
10. Write a balanced equation for the reaction that took place between the magnesium metal and the hydrochloric acid
11. Elements that tend to give up electrons most easily are said to be the most electropositive. Are there any elements in this experiment which are more electropositive than hydrogen?
12. Check the Activity Series in your textbook. Does your order of the 6 metals appear in the same order as that found in the textbook?
13. Does the class' order of the metals appear in the same order as that found in the textbook[7]

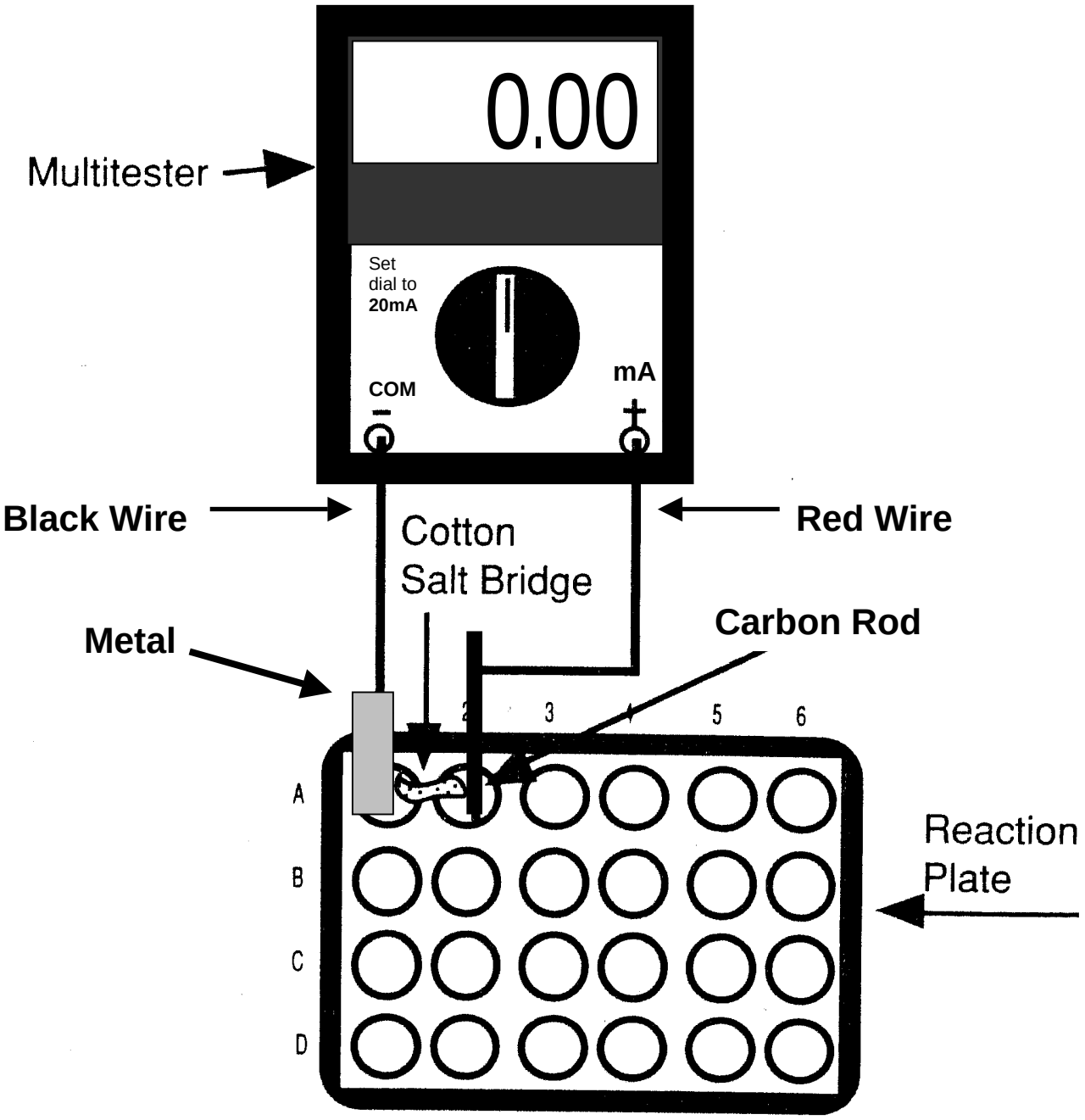
METAL	CURRENT (mA)	Class Average (mA)

My Activity Series

Class Activity Series

most active

least active


0.00
Multitester
Set
dial to
20mA
COM
mA
Black Wire
Red Wire
Cotton
Salt Bridge
Metal
Carbon Rod
1
2
3
4
5
6
A
B
C
D
Reaction
Plate