Name: _____

Lab 25. Oxidation and Reduction

Background

Redox reactions involve the transfer of electrons from one atom to another. Sometimes the transfer is obvious, as when ions change charges, and sometimes the electron donors and acceptors (reductants and oxidants) are separated far enough that the transferring electrons can be transmitted through wires and power electrical devices.

Materials

Activity 1: Potato, magnesium ribbon, copper ribbon, zinc ribbon, voltmeter

Activity 2: Dropper bottles containing 1M aqueous solutions of $Mg(NO_3)_2$, $CuSO_4$, $FeCl_3$, $Zn(NO_3)_2$, and HCl; samples of metallic Mg, Fe, Cu, and Zn. Test tubes, test tube rack, spatulas, marker.

Activity 1. Potato cell

(10 points) An electrochemical cell has been constructed by sticking electrodes made of three different metals—copper, zinc, and magnesium—into a single potato. The interior of the potato conducts electricity enough to allow the metals to transfer electrons. You will measure the electric potential difference ("voltage") between the three electrodes. The electric multimeter has two probes, one color-coded red and the other black. The red probe is the "positive" probe: if it is at a higher potential (more positive) than the black probe, the meter will display a positive value. If is at a lower potential (more negative) than the black probe, the meter will display a negative value.

1. Turn on the multimeter by turning the function selector dial to "DCV."
2. Press one of the multimeter probes firmly onto one of the metal electrodes stuck into the potato. Press the other probe firmly onto one of the other metal electrodes. Read the voltage display. Record your findings into Table 1. Indicate which metal is at the higher potential.
3. Repeat with the other two electrode pairs.
4. Turn off the voltmeter.

Table 1. Voltage

Black probe	Red probe	Voltage	Higher V

Activity 2. Single Replacement Reactions

(10 points) In this activity you will contact one elemental metal with an aqueous solution containing an ion of another metal. The elemental metal may reduce the ion to its element, or it may not. If it does, the metal will in turn oxidize to an ion. Here you will try to determine which metals are stronger reductants, and which ions are stronger oxidants.

1. Obtain four test tubes. Place a small sample (not enough to fill the rounded bottom of the test tube) of one of the metals in one of the test tubes. Mark the tube with the symbol of the metal. Repeat with the other three tubes and the other three metals. You now have four different tubes containing small samples of four different metals.
2. Place the test tubes in the rack.
3. Select one of the dropper bottles. Each lab group will use a different aqueous solution.
4. Add the aqueous solution from the dropper bottle to each of your test tubes. Add enough solution so the top of the liquid is about 1 cm above the top of the metal sample.
5. Observe and record the interaction between the metal and the solution.
6. Record the findings of the other groups who contacted the same metals with different aqueous solutions.

Table 2. Single Replacement Reactions

	Metal			
Solution	Mg	Fe	Cu	Zn
$MgSO_4$				
$CuSO_4$				
$FeCl_3$				
$Zn(NO_3)_2$				
HCl				

7. Arrange the four metals and hydrogen in order from the strongest to the weakest reductant.