Name Colton Kreischer Date 9-26-16 Class 1

Small Scale Lab 14

Chemical Activity of Metals

Text reference: ***Chapter 5***

Introduction

Have you ever noticed that some people are more active than others? Some people play a variety of physical sports while other people like to sit and read. You can think of elements in much the same way. In the case of an element, its activity level is a measure of its ability to react chemically with other elements.

Many metals will react with ions of another metal in solution. You can tell that a reaction has occurred because the metallic ions that come out of solution form a solid precipitate of that metal. At the same time, atoms of the more active metal go into solution. Chemists use the degree of activity to predict what changes will occur in certain reactions. For example, a more active metal will always replace a less active metal in a compound. This is called a single replacement reaction, which you will study in more detail in Chapter 9.

In this experiment, you will use three metals and four solutions of compounds that contain different kinds of metallic ions. You will put each metal into a separate sample of each solution and observe what happens. If a reaction occurs, you will notice a solid precipitate forming on the metal. If a particular metal reacts with the ions of many other metals, then that metal is a chemically active metal. If a metal reacts with few or none of the other metals, then it is chemically inactive. From your observations in this experiment, you will be able to arrange the four metals in the order of their chemical activity.

Pre-Lab Discussion

1. What does the term *chemical activity* mean? Chemical activity is a measurement of how reactive the element is with the ions of other elements.

2. What evidence of chemical activity will you be looking for in this investigation? Reactions with ions of other metals.

3. What are the hazards in handling silver nitrate and what precautions should you follow? It is poisonous and will stain/irritate the skin. Always wear latex gloves when handling it.

Problem

How does the chemical activity of each of four metals compare?

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Materials

chemical splash goggles
laboratory apron
well plate
marking pen
latex gloves
4 micropipets, filled with solutions of:
- copper(II) nitrate, $(Cu(NO_3)_2)$
- magnesium nitrate, $(Mg(NO_3)_2)$
- zinc nitrate, $(Zn(NO_3)_2)$
- silver nitrate, $(AgNO_3)$

4 pieces each of the following metals:
- copper
- magnesium
- zinc

eyedropper

Safety

Wear your goggles and lab apron at all times during the investigation. Handle all chemicals with care; avoid spills and contact with your skin. Wear gloves when handling silver nitrate solution. Note the caution alert symbols here and with certain steps of the Procedure. Refer to page *xi* for the specific precautions associated with each symbol.

Procedure

1. Put on your goggles and lab apron. Using the marking pen, label the wells in the well plate from left to right along the top row *1*, *2*, *3*, and *4*. Label the rows down the left side *A*, *B*, *C*, and *D*.
2. Use the micropipet labeled $Cu(NO_3)_2$ to place 8 drops of copper(II) nitrate, $Cu(NO_3)_2$, into wells A1, B1, C1, and D1. See Figure 14–1.
3. Using the micropipet labeled $Mg(NO_3)_2$, place 8 drops of magnesium nitrate, $Mg(NO_3)_2$, into wells A2, B2, C2, and D2.

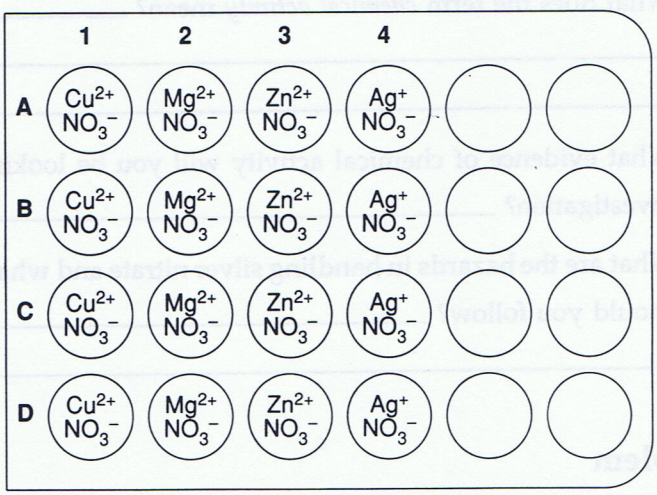

Figure 14–1

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4. Using the micropipet labeled $Zn(NO_3)_2$, place 8 drops of zinc nitrate, $Zn(NO_3)_2$, into wells A3, B3, C3, and D3.

5. Put on latex gloves. Using the micropipet labeled $AgNO_3$, place 8 drops of silver nitrate, $AgNO_3$, into wells A4, B4, C4, and D4. **CAUTION:** *Silver nitrate is poisonous if ingested. Be careful not to get it on your skin or clothing, as it will produce a stain that is hard to remove. If any spills occur, ask your teacher how to clean up safely.*
6. Place one piece of copper metal into each of the wells in row A (wells A1, A2, A3, and A4).
7. Place one piece of magnesium metal into wells B1, B2, B3, and B4.
8. Place one piece of zinc metal into wells C1, C2, C3, and C4. (Note: Strips of silver are not used because of the expense. Had silver been used, you would have been directed to put strips of it into wells D1, D2, D3, and D4. The results you would have obtained have been put into the Data Table for you.)
9. Chemical reactions will take place in some of the wells in rows A, B, and C. Placing the well plate on white paper will make it easier to observe any changes that occur. Observe what happens for five minutes. In the Data Table, record what happens to each metal. If a metal does not change, write NR for No Reaction.
10. Look at the metal samples you used. Describe the appearance of the metals on the lines provided.

11. Use an eyedropper to transfer all the silver nitrate solution from the well plate to a container provided by your teacher. Dispose of all other chemicals according to your teacher's instructions. Clean up your work area and wash your hands before leaving the laboratory.

Observations

DATA TABLE

		1	2	3	4
		Cu^{2+} NO_3^-	Mg^{2+} NO_3^-	Zn^{2+} NO_3^-	Ag^+ NO_3^-
A	Cu	NR	It got shinier	It got shinier	NR
B	Mg	The liquid turned green	NR	NR	The metal emitted a black substance
C	Zn	NR	NR	NR	The metal emitted a black substance
D	Ag	NR	NR	NR	NR

Appearance of metals Look above

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Critical Thinking: Analysis and Conclusions

1. What similarities and differences in physical properties (e.g., hardness, color, shine) did you see when you looked at the metals? *(Making comparisons)* While each metal had similar strength and shininess, they varied in density and color.

2. Which of the four metals reacted with the greatest number of solutions? *(Interpreting data)* Cu/Mg

3. Which of the four metals reacted with the least number of solutions? *(Interpreting data)* Ag

4. List the metals from the most active to the least active. *(Making comparisons)* Cu, Mg, Zn, Ag

Critical Thinking: Applications

1. The Statue of Liberty is made of copper. Use your investigation results to explain why copper is a better material for a statue than magnesium or zinc. *(Applying concepts)* Nothing caused the copper to deteriorate, so it is less reactive than others.

2. Gold does not react with any of the solutions used in this investigation. What does this tell you about gold's chemical activity? *(Making inferences)* Gold has a low chemical activity.

3. How does the chemical activity of gold account for its use in jewelry? *(Applying concepts)* Gold has a low chemical activity, which makes it durable to many substances.

4. Lead is less active than zinc but more active than copper. Predict the results if lead metal is put into separate solutions of zinc nitrate and copper(II) nitrate. *(Making predictions)* The lead will react a small amount to at least one of the nitrates.

Going Further

1. Research the metals that are used to make coins. Explain the choice of these coinage metals in terms of their chemical activity.
2. Visit a cookware store or department and find out what metals are used to make pots and pans. What kinds of foods react with these metals? Explain your findings in terms of the activity of metals.