Your name_____ Lab & Table Number_____

Names of students present in your group _____

SCI 265 INVESTIGATION

PART A: THE PERIODIC TABLE

When we look closely at nature we see patterns of repetition: day is followed by night, followed by another day, and we know we can count on the pattern of spring, summer, fall, winter every year. These patterns are said to be *periodic*. The sun rises *periodically*, and the *period* between sunrises (or the length of time it takes for the sun to return) is called a day. *Periodicity* is an important aspect of nature, and understanding the repetitions of nature is one of the functions of science.

In this investigation we will *observe* properties of some of the elements and seek *patterns* or *regularities* in the observations. The patterns will allow us to group the elements by their properties. Using the properties you obtain, you will also identify an element in an unknown.

Equipment you will need

Beral pipets containing solutions
96-well plate
Q-tips
Bunsen burner
Watch glass

Chemicals you will use

Reagent Solutions (all are 0.5 *M*)
ammonium carbonate, $(NH_4)_2CO_3$
ammonium phosphate, $(NH_4)_3PO_4$
ammonium sulfate, $(NH_4)_2SO_4$

Metal chloride solutions (all are 0.5 *M*)
magnesium chloride, $MgCl_2$
calcium chloride, $CaCl_2$
lithium chloride, LiCl
potassium chloride, KCl
sodium chloride, NaCl
strontium chloride, $SrCl_2$

SAFETY NOTES

1. **No food or drink is allowed in the lab!**
2. Wear approved safety goggles at all times in the lab.
3. All chemicals must be handled carefully and treated with respect. The solutions used in this investigation are safe for you to use carefully and responsibly.
4.Wash your hands before you leave the lab.

PROCEDURE

Part I. Reactions of the metal chlorides

1. Place a few drops of each of the following metal chloride solutions in the order listed in the wells in 3 columns of the well plate: $MgCl_2$, $CaCl_2$, LiCl, KCl, $SrCl_2$, NaCl. (See the data setup on the next page.)
2. In each step below, record your observations. (Does a precipitate form? If so, what does it look like?)
3. To the column labeled, $(NH_4)_2CO_3$, add a few drops of ammonium carbonate solution to each of the metal chloride solutions in that column. Record your observations.
4. Repeat step 3, adding ammonium phosphate solution, $(NH_4)_3PO_4$, to each of the metal chloride solutions in that column. Record your observations.
5. Repeat with ammonium sulfate solution, $(NH_4)_2SO_4$, in the last column. Record your observations.

Part II. Flame Tests

- *Your instructor will demonstrate the flame test technique.*

1. Place a few drops of each of the following into consecutive wells in an empty column of the well plate: $MgCl_2$, $CaCl_2$, LiCl, KCl, $SrCl_2$, NaCl.

2. Using the technique demonstrated, test each of the solutions in the flame, using a **new Q-tip** for each test. Observe the color of the flame and write it on the observation page.

3. Use a new Q-tip between tests, and dispose of them on the watch glass.

Part III. Identifying the metal ion in an unknown

1.Your instructor will give you an unknown. Record its number on your observation page.

2.Write a procedure below for determining which of the solutions, $MgCl_2$, $CaCl_2$, LiCl, KCl, $SrCl_2$, or NaCl, you have been given. **Check your procedure with your instructor before continuing**. Record your observations and identify the solution.

Procedure:

CLEANUP

1. All chemicals used in this experiment can go down the drain. Empty the contents of the well plate in the sink, and rinse the well plate several times to remove all residue, shaking excess water from the plate.

2. Return all boxes of materials to the cart, and wash and dry your lab table.

3. Wash your hands before you leave.

OBSERVATIONS

Part I: Reactions of the metal chlorides ammonium compound

Metal chloride	$(NH_4)_2CO_3$	$(NH_4)_3PO_4$	$(NH_4)_2SO_4$
$MgCl_2$			
$CaCl_2$			
LiCl			
KCl			
$SrCl_2$			
NaCl			

Part II. Flame test

Metal chloride	Observations
$MgCl_2$	
$CaCl_2$	
LiCl	
KCl	
$SrCl_2$	
NaCl	

Part III. Identifying the metal chloride in an unknown

Number of your unknown_____

Identity of the unknown_____

FOLLOW-UP QUESTIONS

1. Look at the observations you made when you added the ammonium compounds to the metal chloride solutions. What patterns do you see?

2. Using the periodic table in your textbook, determine the groups (vertical columns) to which the metals belong. Did your results match the periodic table? In what way?

3. Explain how you used the observations you obtained from the experiments you performed on the unknown to identify it. What is the purpose of the flame test?

4. Using the results of this experiment, explain why the table of elements is called the *periodic* table. (Hint: What occurs periodically?)

5. What would you expect from Rb or Cs in this experiment?

B: USING THE ATOMIC MODEL BOARD

Equipment needed per group: One Atomic Board and Three sets of colored beads.

Matter in our universe is made up of tiny, individual atoms. In some cases they exist as individual atoms such as the helium that is in carnival balloons. In other cases, these atoms have combined together to form the various compounds that make up our world. Examples of these compounds are the sugar that most of us enjoy in candy and the salt that we use on french fries.

Detailed observations of these atoms have shown us they are made up of even smaller particles known as protons, neutrons, and electrons. The protons have a +1 charge and are clumped together at the center of the atom along with the neutrons, which have no charge. The collection of protons and neutrons forms the nucleus (they are called nucleons). The electrons have a -1 charge and are believed to move about the nucleus at relatively large distances compared with the sizes of the individual protons, neutrons, and electrons.

The number of protons in the atoms of a given element is given by the atomic number and the number of neutrons is equal to the mass number of the specific isotopes minus the atomic number. For the most abundant isotope of the given element, the mass number is equal to the rounded off atomic weight. The number of electrons for neutral atoms, i.e., ones that have no charge, is the same as the number of protons.

1. What is an isotope?

2. What is an ion?

Using this and your knowledge of isotopes given below, use the atomic model board to construct models of the various isotope and ions given below. *Use orange beard to represent protons, colorless beads as neutrons, and green beads for electrons.* After you have completed the given isotopes, draw a picture of it.

Using the upper left-hand portion of the board, create the three isotopes of hydrogen. Draw the diagrams below.

Hydrogen-1: Hydrogen-2: Hydrogen-3:

Using the board, do the most abundant isotopes of Helium, i.e. Helium-3 and Helium-4. Draw the diagrams below.

Helium-4: Helium-3:

- *Check with your instructor.*

In a similar manner, do the following isotopes using the right-hand portion of the atomic model board and draw the results as before.

The most abundant isotope of Li:

Oxygen-18:

$^{20}_{10}Ne$

Construct and draw the +1 ion of Sodium-24 (Na-24).
Is this a cation or an ion?

Construct and draw the -1 ion of Fluorine-16 (F-16).
Is this a cation or an ion?

Most elementary schools do not have “atomic model boards”. How could you give your elementary students a concrete example such as this to help with their understanding of these very abstract ideas?