Lab 4-3
Periodic Trends of Chemical Reactivity

Background Information

The periodic table, arranged according to the electron configurations of the elements, can be used to predict the physical and chemical properties of elements and their compounds. The vertical columns of the table are referred to as *groups*; the horizontal rows are called *periods*. General trends exist within groups and periods on the periodic table. Some of these trends include atomic size, ionization energy, electronegativity, density, melting point, and chemical reactivity. For example, the atomic size tends to increase as you move down a group and decrease as you move across a period. As you move down a group, the number of energy levels increase, so there are more "clouds" around the nucleus. As you move across a period, the energy level remains constant, but the number of protons (atomic number) is increasing. The positive nuclear charge is increasing which pulls the electrons closer to the nucleus and therefore reduces the atomic radius.

Valence electrons are the electrons involved in chemical reactions. Metals tend to lose their valence electrons in chemical reactions, and in doing so, produce a full outer energy level like the noble gases. Ionization energy is the amount of energy required to remove an electron from the outer energy level. Nonmetals tend to gain electrons in chemical reactions, and in doing so, produce a full outer energy level like the noble gases. Electronegativity measures the tendency of an atom to gain electrons.

This experiment will investigate chemical reactivity as a function of an element's location within a group and period. You will determine the trend of chemical reactivity of metals as you move down a group and across a period on the periodic table. You will study the reactivities of the alkali metals (Li, Na, K), alkaline earth metals (Mg, Ca), and aluminum (Al).

Procedure (WEAR GOGGLES!!!!)

1. Observe the reactivity of each of the metals (lithium, sodium, potassium, calcium, magnesium, and aluminum) with water. Your teacher will do part of this as a demonstration video. Record your observations in the data table. Remember the observations that signify a chemical change (chemical reaction) is occurring—look for these!
2. Dry off any metals that did not react in water. Add the metals to about 30 mL of 0.5M HCl (hydrochloric acid) in a beaker. Record your observations in the data table.
3. Throw away any metals that did not react (wrapped in a paper towel in the regular trash can). WASH YOUR HANDS BEFORE LEAVING LAB!!!
4. Rank the metals in order of their reactivity from most reactive to least reactive. Record this below your data table for Part A.

Chemistry I

Lab 4-3 Report Name_____

Periodic Trends of Chemical Reactivitiy Period_____

The Pre-Lab (Purpose, Pre-Lab Questions, Hypothesis, Data Table set-up) is due the day before you plan to conduct the experiment.

Purpose Statement: *What is the purpose of this lab?*

Pre-Lab Questions: *Answer the following in your OWN words.*

1. a. Of the metals you are testing, which are the in same group?

   b. Of the metals you are testing, which are in the same period?

2. What are valence electrons and why are they important?

3. a. What is the trend in ionization energy as you move down a group? Explain why in terms of atomic size.

   b. What is the trend in ionization energy as you move across a period? Explain why in terms of atomic size.

4. Why is ionization energy important when discussing metal behavior in a chemical reaction?

Hypothesis

- Predict the trend in chemical reactivity for metals as you move down a group. Explain your prediction.

- Predict the trend in chemical reactivity for metals as you move across a period. Explain your prediction.

Data Table

Read through the entire procedure and prepare a data table that will allow you to record all observations for all the metals.

Data Analysis/Conclusion

1. a. Restate your hypothesis about the trend in reactivity as you move down a group.

   b. What is the trend in reactivity as you move down a group? What evidence do you have for this trend from your experiment?

   c. Was your hypothesis supported or rejected by the data?_____
   d. Explain your observations in reactivity by relating this trend to the trends in atomic size and ionization energy.

2. a. Restate your hypothesis about the trend in reactivity as you move across a period.

   b. What is the trend in reactivity as you move across a period? What evidence do you have for this trend from your experiment?

   c. Was your hypothesis supported or rejected by the data?_____
   d. Explain your observations in reactivity by relating this trend to the trends in atomic size and ionization energy.

3. Would you expect the trend in reactivity of the Halogens to be the same as the reactivity trend you observed in metals? Explain your answer. (Hint: Halogens *gain* electrons in a reaction.)

4. Why did we *not* study the trends in reactivity of the Noble Gases?