T10 – PERIODIC TRENDS 3: METAL CHEMICAL REACTIVITY

You have mastered this topic when you can:

1) define or describe **CHEMICAL REACTIVITY**.
2) describe and provide a theoretical explanation for the ***periodic trends*** for **CHEMICAL REACTIVITY** among metal elements.
3) describe and explain the similarities and differences among elements using the ***periodic trends*** for **ATOMIC RADIUS** and **CHEMICAL REACTIVITY**.

CHEMICAL REACTIVITY

I) **CHEMICAL REACTIVITY** is a description of how a substance reacts with other substances. The ***chemical reactivity*** of elements is a description of how the atoms of an element react with atoms of other elements or compounds or molecules.

II) **EXPLORATION ACTIVITY 1:** Discovering the ***periodic trend*** for ***chemical reactivity*** within metal groups.

A) In this activity you will use your knowledge of the periodic trends studied thus far to predict the periodic trends within group 1, the ***alkali metals***.

B) **INSTRUCTIONS:** Analyze this data table below to then answer the questions below.

DATA:

Alkali metal	*Observations of reaction with water*
Lithium	reacts vigorously as evidenced by the production of a colourless gas, light, heat and sound energy
Sodium	reacts very vigorously as evidenced by production of a colourless gas, more light, more heat and more sound energy
Potassium	reacts extremely vigorously as evidenced by the production of more light, more heat, more sound energy, and a colourless gas that explodes in 5 s
Rubidium	reacts extremely vigorously as evidenced by the production of more light, more heat, more sound energy, and a colourless gas that explodes in 2 s

1. **Analysis:** Based on the observations given in the above **Table**, list the order of the alkali metals in terms of increasing ***chemical reactivity***.

   _____

2. **Hypothesis:** Based on the observations given in the above **Table** and your **Analysis** of those observations, predict the periodic trend for ***chemical reactivity*** within the group of alkali metals. This prediction is the **HYPOTHESIS** that is used to predict reactions with of elements with alkali metals.

   _____

   _____

3. **Synthesis:** Use the ***hypothesis*** created in question 2 and your periodic table to answer these questions.
   a. Predict the ***relative*** reactivity of these pairs of elements.
      i. lithium and francium: _____
      ii. francium and rubidium: _____
      iii. cesium and sodium: _____
   b. Predict possible observations if cesium were added to water.

      _____

      _____

C) Chemists have conducted many experiments comparing the ***reactivity*** of elements within the groups and periods of the periodic table. ***FOUR periodic trends*** were revealed as a result of those experiments – ***two for metals*** and ***two for non-metals***. (The two ***periodic trends*** for the ***chemical reactivity*** of non-metals will be explored in T11.) **THESE ARE THE TWO TRENDS FOR CHEMICAL REACTIVITY AMONG METAL ELEMENTS THAT YOU MUST *MEMORIZE!!***

1) **THE TWO CHEMICAL REACTIVITY TRENDS FOR METALS.**

a)

b)

D) The ***periodic trends*** for ***chemical reactivity*** and ***atomic radius*** are intimately related to each other. As a result, the ***periodic trends*** for ***chemical reactivity*** are explained using the changes in ***atomic radius***, the ***shielding effect*** and the ***force of attraction between protons and valence electrons***.

III) **EXPLORATION ACTIVITY 2:** Explaining the ***periodic trend*** for ***chemical reactivity*** within the groups of metals.

A) Metal elements have a tendency to lose valence electrons when reacting with another element. The more readily the valence electrons are lost the greater the ***chemical reactivity*** of the metal element. In this activity you will use your knowledge of the periodic trends studied thus far to explain the periodic trend for ***chemical reactivity*** within the groups of metals.

INSTRUCTIONS: Draw orbital diagrams for the first three Group 2 elements, the alkaline earth metals, then answer the questions below.

1. State the trend for the ***chemical reactivity*** as the atomic number increases down a group of metals.

2. Describe how the ***atomic radius*** changes as the atomic number increases down a group of metals.

3. Describe how the ***shielding effect*** changes as the atomic number increases down a group of metals.

4. Describe how the ***attraction between the nucleus and valence electrons*** changes as the atomic number increases down a group of metals.

5. Describe how a metal atom's ***ability of to lose valence electrons*** changes as the atomic number increases down a group.

6. Write a theoretical explanation for the ***chemical reactivity*** trend down a group of metals. ***PLEASE USE NUMBERED POINT OR BULLIT FORM.***

B) **THEORETICAL EXPLANATION OF THE *CHEMICAL REACTIVITY TREND* WITHIN A GROUP OF METALS**

1) **THE TREND:**

2) The ***increase in chemical reactivity*** for metals as atomic number increases down a group is explained using the theoretical reasoning outlined below.

a) **THE EXPLANATION FOR THIS TREND:** ***As the atomic number increases down a group of metals, the chemical reactivity increases because...***

IV) **EXPLORATION ACTIVITY 3:** Explaining the ***periodic trend*** for ***chemical reactivity*** within the periods of metals.

A) In this activity you will use your knowledge of the periodic trends studied thus far to explain the periodic trend for ***chemical reactivity*** within the periods of metals.

INSTRUCTIONS: Draw orbital diagrams for the first three period 3 elements, then answer the questions below.

1. State the trend for the ***chemical reactivity*** as the atomic number increases left to right across a period of metals.

2. Describe how the ***atomic radius*** changes as the atomic number increases left to right across a period of metals.

3. Describe how the ***shielding effect*** changes as the atomic number increases left to right across a period of metals.

4. Describe how the ***attraction between the nucleus and valence electrons*** changes as the atomic number increases left to right across a period of metals.

5. How do the changed in the ***shielding effect*** and the ***attraction between the nucleus and valence electrons*** as the atomic number increases left to right across a period of metals compare to each other.

6. Describe how a metal atom's ***ability of to lose valence electrons*** changes as the atomic number increases left to right across a period.

7. Write a theoretical explanation for the ***chemical reactivity*** trend left to right across a period. ***PLEASE USE NUMBERED POINT OR BULLIT FORM.***

B) **THEORETICAL EXPLANATION OF THE *CHEMICAL REACTIVITY TREND* WITHIN A PERIOD OF METALS**

1) **THE TREND:**

2) The ***decrease in chemical reactivity*** for metals left to right across a period is explained using the theoretical reasoning outlined below.

a) **THE EXPLANATION FOR THIS TREND:** ***As atomic number increases left to right across a period, chemical reactivity of metals tends to decrease because...***

ANSWERS TO THE EXPLORATION ACTIVITIES

EXPLORATION ACTIVITY 2 from page 2

1. As the atomic number increases down a group of metals, the chemical reactivity increases. **2**. As the atomic number increases down a group of metals, the atomic radius increases. **3.** As the atomic number increases down a group of metals, the shielding effect increases. **4.** As the atomic number increases down a group of metals, the attraction between the nucleus and the valence electrons decreases. **5.** As the atomic number increases down a group of metals, the metal atom's ability to lose electrons increases.

6. i.e. Chemical reactivity increases as the atomic number increases down a group of metals because…

1. As the Atomic Radius increases…
2. the shielding effect increases, and…
3. the attraction between the nucleus and the valence electrons decreases, which…
4. increases a metal atom's ability to lose valence electrons.

EXPLORATION ACTIVITY 2 from page 3

1. As the atomic number increases left to right across a period the chemical reactivity of metals decreases. **2.** As atomic number increases left to right across a period of metals the shielding effect increases. **3.** As atomic number increases left to right across a period of metals the shielding effect increases. **4.** As the atomic number increases left to right across a period of metals the attraction between the nucleus and the valence electrons increases. **5.** As the atomic number increases left to right across a period of metals the attraction between the nucleus and the valence electrons increases more than the shielding effect. **6.** As the atomic number increases left to right across a period of metals, the metal atom's ability to lose electrons decreases.

7. i.e. As the atomic number increases left to right across a period, chemical reactivity of metals decreases because

1. As the Atomic Radius decreases…
2. the shielding effect increases, while…
3. the attraction between the nucleus and the valence electrons increases more, which…
4. decreases a metal atom's ability to lose valence electrons.

BRING GRID PAPER NEXT CLASS!!
