Chemistry 10: Application of knowledge to elements, periodic trends.

April 14-April 17 (break on April 13)

Time Allotment: 40 minutes per day

Student Name: _____

Teacher Name: _____

Academic Honesty

I certify that I completed this assignment independently in accordance with the GHNO Academy Honor Code.

Student signature:

_____

I certify that my student completed this assignment independently in accordance with the GHNO Academy Honor Code.

Parent signature:

_____

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Packet Overview

Date	Objective(s)	Page Number
Monday, April 13	*Holiday – April Break.*	3
Tuesday, April 14	*Nonmetals and Metalloids*	6
Wednesday, April 15	*Group trends for the alkali metals.*	10
Thursday, April 16	*Group trends for the earth metals*	13
Friday, April 17	*Group trends for selected nonmetals.*	17

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Additional Notes:

Hi students.

This week you'll be walking through parts of the periodic table. This isn't an exhaustive task, but is a powerful tool for being more familiar with the *urstoff*—the primordial substances that make up our world. You should expect to be developing, slowly, and begin to do more (leisurely) thinking about elements and their relations.

I hope you enjoy! The goal is to have a quiz or a test in the next week, where all of the facts and relationships you encounter this week are fair game.

Please email me at any time, with any questions.

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Tuesday, April 14

Chemistry Unit: Application of knowledge to elements, periodic trends
Lesson 1: Nonmetals and Metalloids

Unit Overview

A Question for Lesson 1: What makes a nonmetal a nonmetal? What makes metalloids metalloids?

Objective: Be able to do this by the end of this lesson.

Use the periodic table, knowledge of electron configurations, and atomic properties to predict chemical and physical properties about nonmetals and metalloids.

Introduction to Lesson 1

Name a few nonmetals.

_____ _____ _____

Do they tend to take electrons or give them?[1] Give some reason.

_____

A compound XCl_3 (where X is an unknown element and Cl is chlorine) has a melting point of -112°C. Based on these two facts, X is probably a metal/nonmetal (circle one)

Read and annotate pages 279 and 280, then answer the questions below.

A **molecular substance** is: _____

Most nonmetal oxides are acidic/basic (circle one).

Identify the "nonmetal oxides":

MgO
Na_2O
CO_2
P_4O_{10}

[1] Mind going blank? Remember, you're now an advanced chemistry student. When things give or take electrons they become _____. Nonmetals tend to take a _____ charge.

Based on the rule above, which is the more likely product?

$CO_2 + H_2O \rightarrow$ _____?

a. no product (no reaction occurs)
b. H_2CO_3

$P_4O_{10} + 6\ H_2O \rightarrow$ _____?

a. no product (no reaction occurs)
b. $4\ H_3PO_4$

Name the metalloids.

_____ _____ _____ _____ _____ _____

Name three reasons why the metalloids are called the metalloids (and not "the metals" or "the nonmetals")

Complete the following problems:

7.53

_____

7.54

_____

7.57

_____

Challenge:

7.58

_____

_____

7.59

_____

_____

Nice work! If you'd like to do more chemistry today, there's a really interesting report on lithium ions on page 284 of your textbook (CHEMISTRY AND LIFE | The Improbable Development of Lithium Drugs).

Wednesday, April 15

Chemistry Unit: Application of knowledge to elements, periodic trends
Lesson 2: Alkali metals

Unit Overview

Objective: Be able to do this by the end of this lesson.

Use the periodic table, knowledge of electron configurations, and atomic properties to predict chemical and physical properties about alkali metals

A Question for Lesson 2: What makes an alkali metal unique among the elements?

Introduction to Lesson 2

Note the 6 alkali metals. Where are the alkali metals on the periodic table?

The alkali metals are in the first column of the periodic table (sans Hydrogen). Now, given your current knowledge do your best to predict what will happen as you move down the periodic table.

As you move from Lithium to Cesium, you would expect:

I. The number of protons to increase/decrease (circle one)
II. The number of electrons to increase/decrease (circle one)
III. The atomic radius (size of the atom) to increase/decrease (circle one)

Why?

IV. The ionization energy (required to remove 1 electron) to increase/decrease (circle one)

Why?

Two tough ones, just for fun:

V. The density to increase/decrease (circle one)

Why?

VI. As you move down the table, you'd expect elements to be easier/harder to melt (the melting point temperature will be lower/higher).

What two of the alkali metals would you expect most people to have heard of? _____ and _____.

Read pages 281, 282, and 283, then check your answers to the above questions.

Answer the questions below:

List 5 important facts about sodium and potassium below:

_____
_____
_____
_____
_____

Why are the alkali metals called "alkali"?

_____
_____

Potassium was first isolated from a substance called "potash", a type of ash developed from the burning of potassium-rich vegetables and leaching the ashes. Sodium was first isolated from a substance called "soda ash" by the same method.

Alkali metals are **never** found in the pure state. They're always found combined with other elements. Left alone, they tend to react in two primary ways, with H_2O and O_2.

Characterize the reaction between an alkali metal and H_2O.

The chemical reaction: _____ → _____
A written description of what happens:

_____
_____
_____

Why is the reaction of Sodium with water more violent than the reaction of Potassium with water? Why is the the reaction of Cesium with water *extremely* violent? Explain, using the term "ionization energy" somewhere in your explanation.

_____

_____

Characterize the reaction between Li and O_2 gas.

The chemical reaction: _____ → _____
A written description of what happens:

_____

_____

_____

Characterize the reaction between sodium and O_2 gas.

The chemical reaction: _____ → _____

A written description of what happens:

_____

_____

_____

Characterize the reaction between potassium, rubidium, or cesium and O_2 gas.

The chemical reaction: _____ → _____

What is the difference between the reaction of sodium with O_2 versus the reaction of K, Rb, or Cs with O_2?

_____

Write the color with which each alkali metal burns when put in a flame:
Li : _____
Na: _____
K: _____
Rb: _____
Cs: _____

There are many videos of varying quality showing demonstrators drop differing amounts of different alkali metals into water. You're welcome to look for different examples. One can be found here:

"Alkali Metals - 20 Reactions of the alkali metals with water"
https://www.youtube.com/watch?v=eaChisV5uR0

Nice work. Good day to you ☺

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Thursday, April 16

Chemistry Unit: Application of knowledge to elements, periodic trends
Lesson 3: Alkali earth metals

Unit Overview

Lesson 3 Socratic Question: What makes the alkali earth metals characteristically themselves? How are they distinct from their cousins, the alkali metals?

Objective: Be able to do this by the end of this lesson.

Use the periodic table, knowledge of electron configurations, and atomic properties to predict chemical and physical properties about alkali earth metals.

Introduction to Lesson 3

You're getting a good sense of things on the periodic table. Today, note the 6 alkali earth metals. Where are they on the periodic table?

As you move from Beryllium to Barium, you would expect:

I. The number of protons to increase/decrease (circle one)
II. The number of electrons to increase/decrease (circle one)
III. The atomic radius (size of the atom) to increase/decrease (circle one)
IV. The ionization energy (required to remove 1 electron) to increase/decrease (circle one)

Why?

V. As you move down the column, you'd expect density to increase/decrease (circle one)
VI. As you move down the column, you'd expect elements to be easier/harder to melt (the melting point temperature will be lower/higher).

Would you expect these elements to have a higher or lower atomic radius?
a higher or lower melting point than the alkali metals?
a high or a low ionization energy?

The alkali earth metals, in general, have a lower ionization energy than alkali metals. This means that they easily lose electrons, therefore sharing and forming covalent (or ionic) bonds more easily. However, their ionization energy is a little **higher** than the ionization energy of the alkali metals. Would you expect them to be more --or less-- reactive than the elements in the first column?

Read page 285 in your textbook. Then, check your answers to the questions above.

Answer the questions below.

All the alkali earth metals react with H_2O. However,

Be and Mg only react with H_2O (g).

Ca, Sr, and Ba react with H_2O (g) **and** H_2O (l).

Explain this difference, in terms of reactivity and energy state.

_____
_____
_____

Characterize the reaction between an alkali earth metal and H_2O.

The chemical reaction: _____ → _____
A written description of what happens:
_____
_____
_____

When the alkali earth metals react with water, they tend to form salts with *two* hydroxide (-OH) ions. For example, $Ca + H_2O \rightarrow Ca(OH)_2$. Compare this to sodium, which reacts with water to form:

$$Na + H_2O \rightarrow NaOH$$

Why do the alkali earth metals bind with *2* -OH ions, whereas alkali metals only bind with one?
_____
_____
_____

Write the color taken by each alkali earth metal when placed in a flame:

Be: _____
Mg: _____
Ca: _____
Sr: _____
Ba: _____

Circle the alkali earth metals that are most important to living growth.

Why can Mg, an extremely reactive metal, be used as part of machinery (without exploding)?
_____

Tying together [10 minutes]

Take some time now and identify some primary differences between alkali and alkali earth metals. Consider atomic properties (ionization energy, atomic size, etc), chemical properties (reactivity, reaction behavior), as well as physical properties in your analysis. Be thorough in your analysis, and be sure to strike at the heart of the matter—what *really* sets these two groups apart?

Friday, April 17

Chemistry Unit: Application of knowledge to elements, periodic trends
Lesson 4: Selected nonmetals

Unit Overview:

Lesson 3 Socratic Question: What can ionization energy and context tell me about these specific elements?

Objective: Be able to do this by the end of this lesson.

Use the periodic table, knowledge of electron configurations, and atomic properties to predict chemical and physical properties about some specific nonmetals.

Introduction to Lesson 4

A good Friday to you. ☺

Is Hydrogen a metal? Consider physical properties, like color and state of matter, but also consider properties like its ionization energy, atomic size, known behavior in reactions (does it tend to lose/gain electrons, how many electrons does it lose/gain etc). **Pick a side and argue**.

Claim: Hydrogen (is/is not) a metal.

_____

_____

Evidence 1:

_____

_____

_____

Evidence 2:

_____

_____

Evidence 3:

_____

_____

Read the section on Hydrogen on page 286. Were you right?

What evidence would you have used, if you had remembered/known? What new/interesting fact(s) have you learned about Hydrogen?

_____

_____

_____

Now let's move to three important columns of the periodic table: Group 14, 15, and 16 (also known as Group "6A", "7A", and "8A". Open your textbook and read about Oxygen and Sulfur, the Halogens, and the Noble Gases, using the space below to take notes.

Group 14 (6A)

Oxygen

allotropes (define):

O_2 molecules make up about ____% of air.

What happens when compounds with peroxide or superoxide are allowed to sit at room temperature:

The equation for the decomposing of H_2O_2: _____ → _____

Sulfur

Most common allotrope of sulfur (draw):

Group 15

"halogen" comes from the Greek words _____ and _____

State of matter at RT:
F
Cl
Br
I

You (would/would not) expect a Cl, F, Br, or I atom to be found by itself.

The halogens have "highly negative electron affinities". This means:
_____.

Rank the halogens in order of reactivity.

Copy Table 7.7 below:

Group 16

Copy Table 7.8 below:

Notes:

Post-reading questions:

Why is it that the heaviest noble gases are able to react with **some** (albeit very reactive) elements, while the rest are totally unable to react?

_____

_____

_____

Draw Lewis diagrams to describe what was happening at the atomic level when Bartlett synthesized the first noble-gas compound. The chemical equation for the reaction is given on page 289.