Name _____ **Period**_____

POGIL Periodic Table TRENDS Part 1

The Periodic Table is a map of the elements. There are many patterns or trends on the periodic table. Let's look and see what we can find.

Periods: (Horizontal)
Look at Na to Ar to answer the following questions. (Choose INCREASES, decreases, or remains the same.)

1. The atomic # (INCREASES, decreases, or remains the same.)
2. The # of protons (INCREASES, decreases, or remains the same.)
3. The # of valence electrons (INCREASES, decreases, or remains the same.)
4. The # of principle energy levels (INCREASES, decreases, or remains the same.)
5. All elements in the same period have the same _____

Groups: (Vertical)
Look at H to Fr to answer the following questions. (Choose INCREASES, decreases, or remains the same.)

1. The atomic # (INCREASES, decreases, or remains the same.)
2. The # of protons (INCREASES, decreases, or remains the same.)
3. The # of valence electrons (INCREASES, decreases, or remains the same.)
4. The # of principle energy levels (INCREASES, decreases, or remains the same.)
5. All elements in the same group have the same _____ and therefore react similarly.

Practice:

_____1. Which element would be expected to have chemical and physical properties closest to those of fluorine?
a. Fe b. Cl c. S d. Ne

_____2. Chlorine and bromine have very similar chemical properties. This is best explained by the fact that both elements
a. have equal number of protons and electrons.
b. are gases.
c. are in period 3 of the Periodic Table.
d. have the same number of valence electrons.

_____3. The elements in the alkali metals are all part of the same:
a. Group b. Period c. Element d. Transition

Atomic Radius:

The atomic radius (or radii) is the distance from the center of the nucleus to the outer edge of the atom. This is used to tell how big the atom is. Look at your table S in your reference table and see if you can find these values. Let's look at some trends for these. Write down the information below for each element.

The atomic radius is affected by 2 things: the number of principle energy levels and the attraction between protons and electrons. When comparing atomic radii, first, look at principle energy level….the more principle energy levels (p.e.l), the bigger the atom. Then, if the p.e.l. are the same, look at the number of protons to the number of electrons….more protons, means more attraction for electrons, and the electrons get sucked in closer to the nucleus, shrinking the atom.

Periods: (Examine the elements in period 3 on the Periodic Table and with Table S)

Na: **Radius** _____
# of principle energy levels _____
# of protons _____
# of electrons _____

Si: **Radius** _____
# of principle energy levels _____
# of protons _____
# of electrons _____

Cl: **Radius** _____
# of principle energy levels _____
# of protons _____
# of electrons _____

Circle one: The radius *(increases or DECREASES)* as you go across a period due to **an increase in the number of PROTONS in nucleus pulling electrons closer**

Groups: (Examine the elements in group 1 on the Periodic Table and with Table S)

Li: **Radius** _____
# of principle energy levels _____
# of protons _____
# of electrons _____

K: **Radius** _____
# of principle energy levels _____
# of protons _____
# of electrons _____

Cs: **Radius** _____
# of principle energy levels _____
# of protons _____
# of electrons _____

Circle one: The radius *(INCREASES or decreases)* as you go down a group due to **more energy levels (shells of electrons)**

Practice:

_____1. Atomic radius generally increases as we move _____.
a. down a group and from right to left across a period
b. up a group and from left to right across a period
c. up a group and from right to left across a period
d. down a group; the period position has no effect

_____2. Which one of the following atoms has the largest radius?
a. O
b. F
c. S
d. Cl

_____3. Which one of the following has the smallest radius?
a. Na
b. Cl
c. P
d. Br

_____4. In which of the following atoms are the valence electrons closest to the nucleus?
a. Br
b. Cl
c. At
d. I

_____5. Which of the following correctly lists the five atoms in order of increasing size (smallest to largest)?
a. O < F < S < Mg < Ba
b. F < O < S < Mg < Ba
c. F < O < S < Ba < Mg
d. O < F < S < Ba < Mg

POGIL Periodic Table TRENDS Part 2

Electronegativity

Electronegativity is a measure of an atom's ATTRACTION for electrons in a bond with another atom. Electronegativity is measured on a scale of 0 to 4, with 4 being the highest electronegativity value. Fluorine, F, is the most electronegative element with a value of 4. Fluorine is located in the upper right corner of the Periodic Table. In general, the closer an atom is to F, the higher its electronegativity value. So, as you go *across a period* or *up a group* (toward F), electronegativity values increase. These values can also be looked up in Table S.

Ionization Energy

Ionization energy is the amount of energy required to REMOVE an electron from an atom in the gaseous state. This property of atoms is directly related to their electronegativity values – the *more attracted to electrons* they are, the *more energy* it will take to pull an electron away. Ionization energies are also listed on Table S.

Fill in the table below for the elements in Period 2 and Group 2 to note the general pattern of values.

Period 2 Elements	Li	Be	B	C	N	O	F
Electronegativity							
Ionization Energy (kJ/mol)							

*__Circle One__: In general, as you go **across a period**, electronegativity and ionization energy *(INCREASES OR DECREASES)*

*__Circle One__: …This is because the number of *(protons or electron shells)* increases, so attraction to outermost electrons *in*creases.

Group 2 Elements	Electronegativity	Ionization Energy (kJ/mol)
Be		
Mg		
Ca		
Sr		
Ba		

* __Circle One__: In general, as you go **down a group**, electronegativity and ionization energy *(INCREASES OR DECREASES)*

*__Circle One__: …This is because the number of *(protons or electron shells)* increases, so attraction to outermost electrons *de*creases.

Practice:

_____1. The first ionization energies of the elements _____ as you go from left to right across a period of the periodic table, and _____ as you go from the bottom to the top of a group in the table.

a. increase, increase
b. increase, decrease
c. decrease, increase
d. decrease, decrease

_____2. Of the choices below, which gives the order for increasing first ionization energies?

a. Cl > S > Al > Ar > Si
b. Ar > Cl > S > Si > Al
c. Al > Si > S > Cl > Ar
d. Cl > S > Al > Si > Ar

_____3. Of the following atoms, which has the largest first ionization energy?

a. Br
b. O
c. C
d. P

_____4. Of the atoms below, _____ is the most electronegative.

a. Br
b. O
c. Cl
d. N

_____5. Of the atoms below, _____ is the least electronegative.

a. Rb
b. F
c. Si
d. Cl

Ionic Radius

As you know, all of the noble gases are very stable. Ions form in such a way so that the ion will have the same number of electron as a noble gas. Take oxygen for example: Oxygen has 6 valence electrons. To become like a noble gas it could either gain two electron to become like neon or it could lose 6 electrons to become like helium. As a general rule, atoms will gain or lose the fewest number of electrons possible.

*A **cation** is a positively charged ion. It has lost electrons, so it has more positive protons than negative electrons.*

*An **anion** is a negatively charged ion. It has gained electron, so it has more negative electron than positive protons.*

Answer the following questions:

1) Look at oxygen on the Periodic table. An oxygen atom has an overall neutral charge because it has an equal number of protons and electrons. What is the overall charge of an oxygen *ion*?

2) What does an oxygen atom do when becoming an ion? (Does it gain or lose electrons?)

3) Is an oxygen ion an anion or a cation?

4) Consider an aluminum atom.
   a. To become like argon, would aluminum have to gain or lose electrons?

   b. How many?

   c. To become like neon, would aluminum have to gain or lose electron?

   d. How many?

   e. Considering you answers to part a through d, would it be lower energy for an aluminum atom to gain electrons or to lose electrons to become an ion?

   f. What is the charge on an aluminum ion?

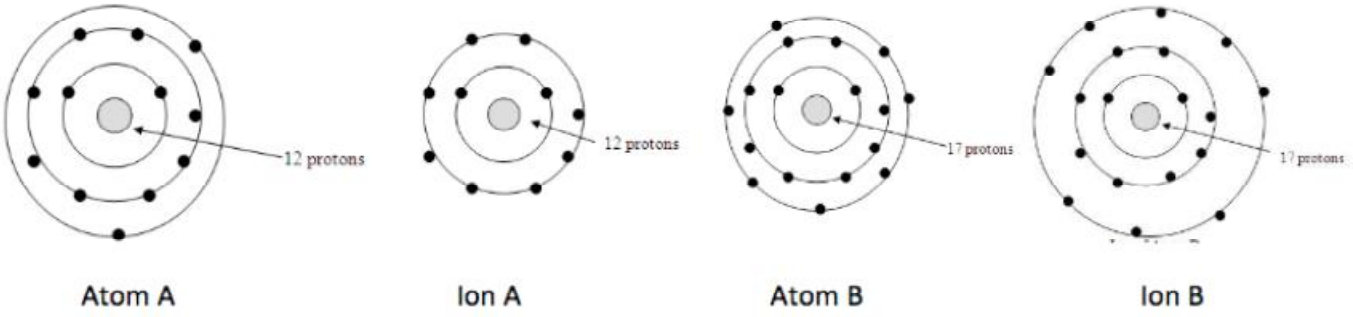
   g. Is an aluminum ion an anion or cation?

5) If the following atoms became ions, what will their charges be? Will they be anions or cations?

	Ca	**Cl**	**N**	**K**	**S**	**B**	**P**
Charge							
Anion or cation?							

Part II: The Trend!

When an atom becomes an ion, its radius changes because the number of electrons in its energy levels has changed. The diagrams below show the relative sizes of atoms of two elements and the ions they form



Answer:

6) Are cations larger or smaller than their atom?_____

7) Are anions larger or smaller than their atom? _____

8) Draw Bohr diagrams for an atom of Lithium (Li) and an ion of Lithium (Li^{+1}).

9) Does the amount of positive charge in the nucleus change when lithium becomes an ion?

10) Does the amount of negative charge in the electron cloud change when lithium becomes an ion?

11) Using your Bohr diagram and answers from above, explain why lithium's ionic radius is smaller than its atomic radius.

12) Draw a Bohr diagram for an ion of sodium (Na^{+1}).

13) Using your Bohr diagrams for the lithium ion and the sodium ion, how does ionic radius change as you go down a column on the periodic table? Explain this trend.