**Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_ Period \_\_\_\_\_\_**

**Electron Arrangement and Periodic Trends Activity**

**Element Electron Configuration Orbital Diagram**

2s

Carbon 1s2 2s2 2p2

2p

1s

**Get Started Questions:**

Use the examples above and your understanding of e- arrangement to complete the following:

1. For the element magnesium:
	1. Write the electron configuration \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. Draw the orbital diagram:
	3. Write an electron configuration for an Mg2+ ion \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. For the element fluorine:
	1. Write the electron configuration \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. Draw the orbital diagram:
	3. Write an electron configuration for an F- ion \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Compare the electron arrangement and number of energy levels in the Mg and F atoms.
4. Compare the electron arrangement and number of energy levels in the Mg2+ and F- ions.
5. Which electrons, in an atom of magnesium, are farthest from the nucleus? Explain why.
6. Define each of the following terms and relate each to an atom of magnesium.

	1. valence electrons
	2. atomic radius
	3. ionization energy

 **Data Table 1**: Write the electron configurations for each of element in Group 1A. You can use abbreviated.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Element Symbol** | **Electron Configuration** | **# of valence electrons** | **Energy level of outermost electron** | **Nuclear Charge** | **# of electrons in neutral atom** |
| H |  |  |  |  |  |
| Li |  |  |  |  |  |
| Na |  |  |  |  |  |
| K |  |  |  |  |  |
| Rb |  |  |  |  |  |

**Group 1 Trends**: Moving ***down a group*** on the periodic table, what trends do you see from the data?

* 1. **Trend in Electron Configuration:**
	2. **Trend in Valence Electrons:**
	3. **Trend in Energy level of outermost e-:**
	4. **Trend in nuclear charge:**
	5. **Trend in # of e- in neutral atom:**

**Data Table 2:** Write the electron configurations for the elements in Period 3. You can use abbreviated.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Element Symbol** | **Electron Configuration** | **# of valence electrons** | **Energy level of outermost electron** | **Nuclear Charge** | **# of electrons in neutral atom** |
| Na |  |  |  |  |  |
| Mg |  |  |  |  |  |
| Al |  |  |  |  |  |
| Si |  |  |  |  |  |
| P |  |  |  |  |  |
| S |  |  |  |  |  |
| Cl |  |  |  |  |  |
| Ar |  |  |  |  |  |

**Period 3 Trends:** Moving ***across a period*** on the periodic table, what trends do you see from the data

* 1. **Trend in Electron Configuration:**
	2. **Trend in Valence Electrons:**
	3. **Trend in Energy level of outermost e-:**
	4. **Trend in nuclear charge:**
	5. **Trend in # of e- in neutral atom:**

**Graph 1:** Atomic Radius and Ionization Energy

1. Use the graph paper below to graph the data on the back of the handout at your lab table.
2. Between you and a partner, construct two graphs (one graph by each person). One person needs to graph Atomic Radius (nm) vs Atomic Number and the other person needs to graph First Ionization Energy (kJ/mol) vs Atomic Number. The X axis for each of you will be the same. After plotting the data, make a line graph by ***connecting each point***.

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1. Sketch AND label the graph your partner made below.

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**Data Table 3:** Using the graphs you made, record the atomic radius and ionization energy of the elements in group 1 (hint: use their atomic numbers).

|  |  |  |  |
| --- | --- | --- | --- |
| **Element** | **Atomic Number** | **Atomic Radius (approx)** | **Ionization Energy (approx)** |
| H |  |  |  |
| Li |  |  |  |
| Na |  |  |  |
| K |  |  |  |

**Group 1 Atomic Radius and Ionization Energy Questions:**

1. Moving down group 1 on the periodic table, what trends do you see in terms of atomic radius?
2. Moving down group 1 on the periodic table, what trends do you see in terms of ionization energy?

**Data Table 4:** Using the graphs you made, record the atomic radius and ionization energy of the elements in Period 3 (hint: use their atomic numbers).

|  |  |  |  |
| --- | --- | --- | --- |
| **Element** | **Atomic Number** | **Atomic Radius (approx)** | **Ionization Energy (approx)** |
| Na |  |  |  |
| Mg |  |  |  |
| Al |  |  |  |
| Si |  |  |  |
| P |  |  |  |
| S |  |  |  |
| Cl |  |  |  |
| Ar |  |  |  |

**Period 3 Atomic Radius and Ionization Energy Questions:**

1. Moving across a period on the periodic table, what trends do you see in terms of atomic radius?
2. Moving across a period on the periodic table, what trends do you see in terms of ionization energy?

**Organizing Elements in the Periodic Table**

*Read the procedure sheet for Organizing Elements in the Periodic Table.*

1. Show your arrangement of elements in the table below by recording the letters (A, B, C …) in the correct position. *The letters have no connection to the elements they represent.*
2. Label the arrows across the top of the table as Ionization Energy, Valence Electrons, and Atomic Radius.
3. Describe how each of the properties changes from left to right across the rows.
4. Do the same for the arrows on the side of the table.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
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**Analysis Questions:**

1. Using the electron configurations you wrote previously, state ONE difference and ONE similarity of the electron configurations of ***Group 1 metals***.
2. Using the graph of Atomic Radius vs Atomic Number or the table above, describe the attraction between the protons in the nucleus and the electrons of the atoms ***for Group 1 metals***.
3. As you move down (from top to bottom) on the periodic table ***in Group 1***, explain:
	1. the trend in Atomic Radius
	2. the trend in Ionization Energy

*Your explanation should include information such as electron configuration, size of the atom, energy level, proton-electron attraction, nuclear charge, shielding... Justify your explanation by using numbers from the data.*

1. Using the electron configurations you wrote previously, state ONE difference and ONE similarity of the electron configurations ***of Period 3 elements***.
2. Using the graph of Atomic Radius vs Atomic Number or the previous table, describe the attraction between the protons in the nucleus and the electrons of the atoms ***for Period 3 elements***.
3. As you move across (from left to right) on the periodic table through Period 3, explain:
	1. the trend in Atomic Radius
	2. the trend in Ionization Energy

*Your explanation should include information such as electron configuration, size of the atom, energy level, proton-electron attraction, nuclear charge... Justify your explanation by using numbers from the data!*

1. Identify the 2 most important characteristics of atomic structure when predicting atomic radius or ionization energy.
2. Consider the Mg+2 and F- ions (refer back to page 1 to look at e- configurations). Which of these ions would have the smallest atomic radius? Explain your answer.
3. Compare the ionization energies for magnesium and fluorine. Explain why a magnesium atom always loses electrons and a fluorine atom always gains an electron when forming ions. Include numbers.
4. Suppose that a stable element with an atomic number of 119, symbol Q, has been discovered.
	1. Write the ground-state electron configuration for element Q, **showing only the valence-shell electrons**.
	2. Based on the number of valence-shell electrons, would you expect element Q to be a metal or a nonmetal? Explain your prediction in terms of the electron configuration.
	3. On the basis of periodic trends, would Q have the largest atomic radius in its group or would it have the smallest? Explain your prediction in terms of atomic structure.
	4. On the basis of periodic trends, would element Q have the highest ionization energy of its period or would it have the lowest? Explain your prediction in terms of atomic structure**.**