Chapter 7: Periodic Relationships among the elements

1. Explain the concept of ionization energy.
2. Explain the effects of increasing nuclear charge on the radial density function in many-electron atoms.
3. Explain the variations in atomic radii among the elements, (see handouts that follow) and predict the relative sizes of atoms based on their position in the periodic table.
4. Explain the observed changes in values of the successive ionization energies for a given atom.
5. Explain the general variations in first ionization energies among the elements (see graphs in hand outs that follow) and relate these variations to variations in atomic radii.
6. Explain the variation in electron affinities among the elements..
7. Describe the periodic trends in metallic and nonmetallic behavior.
8. Describe the general differences in chemical reactivity between metals and nonmetals.
9. Describe the general physical and chemical behavior of the alkali metals and alkaline earth metals, and explain how their chemistry relates to their position in the periodic table.
10. Write balanced equations for the reactions of hydrogen with metals to form metal hydrides.
11. Write balanced equations for simple reaction between the active metals (Group 1A and 2A) and the non-metals in groups' 6A and 7A.
12. Write balanced equations for the reaction of hydrogen with non-metals such as oxygen and chlorine.
13. Explain the dominant reactions of oxygen and relate these to its position in the periodic table.
14. Describe the physical states and colors of the halogens and explain the trends in reactivity with increasing atomic number in the family.
15. Explain the very low chemical reactivity of the noble gas elements.

Of Interest:

- The **valence orbitals** are those that are occupied beyond the orbitals of the preceding noble gas. These orbitals do not necessarily have the highest values of n.
- The idea of "electron shells" is useful in visualizing the atom. However, it is a poor description of atomic structure.
- When taken further, shielding can explain most inconstancies in the periodic properties of the elements.
- The concept of size of an atom is arbitrary. The atomic radius discussed in class in only one definition.
- Tabulated atomic radii are averages of many experimental results. In any particular compound, the actual radius of an atom may deviate from the average. However, atomic radii are very useful general predictive tools.
- As one moves to the right in a period, shielding does not increase appreciable, but the nuclear charge does. Therefore, effective nuclear charge increases steadily as you move to the right along a period.
- Ionization energy is defined with both product and reactant in the gas phase. Ionization energies of the atomic elements are always positive; that is, energy is absorbed from the surroundings; the ionizations are endothermic.

- Due to the large increase in the ionization energy when the electron comes from the next lower value of n, it is seldom necessary to consider ionizations that take more electrons than needed to achieve a noble gas electron configuration.
- The easily removed electrons are the valence electrons.
- Within a period the first ionization energy generally increases as you move to the right. With in a group, the first ionization energy generally decreases as you move down.
- Electron affinity is defined with both product and reactant in the gas phase.
- For most neutral atoms and for all cations, energy is evolved when an electron is added. As a consequence, the sign of the ΔE is negative.
- Because hydrogen shares little in common with the other members of group 1A other than outer shell electron configuration and common cationic charge, some sources place hydrogen above the center of the periodic table and some, in group 7A.
- Hydride is the anion of hydrogen. It has the electron configuration of He. The formation of an anion is one of the properties of hydrogen that makes it different form the alkali metals with which it is often grouped.
- The exact placement of electrons in Lewis symbols is somewhat arbitrary. However, always use four regions and obey Hund's rule.
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