Every atom is different in its number of protons, its mass, and its size. The size of the atoms is determined by the size of their orbitals. The larger the quantum number "n" is, the larger the orbital is, which increases the size of the atom.

**Introduction**

Each atom has different number of orbitals. These orbitals differ in size depending on where they are on the periodic table. The size of the orbitals determines the atomic radius for each atom. As you go down a group, the quantum number "n" increases meaning that the size of the orbital and the atomic radius increases as well.

**Relation to Quantum Numbers**

Every atom has four quantum numbers, but the only one that matters in the size of the atom is the quantum number "n". As "n" increases, so does the size of the orbital. As "n" decreases, the size of the orbital decreases as well.

**Size of Orbitals and Atomic Radii**

The size of the orbital determines the radius of an atom. As you go down a group on the periodic table, the size of the orbital increases meaning the atomic radius increases as well. The increase of size in the orbital is due to the increase of the quantum number "n".

The size of the orbital and the atomic radii decreases as you go across a period from left to right. This is due to the fact that as you go from left to right across a period, the number of protons increase as well as the number of electrons. The more electrons there are, the closer they are to the nucleus due to the stronger interactions between them, which decreases the size of the orbital and the atomic radius.

Figure 1. General Trend of how the radius change within the Periodic Table
Cations and Anions

The atomic radii of cations and anions follow a different trend compared to the neutral atoms. Cations have less electrons than their neutral atoms. Since there are less electrons, they are more attracted to the increased positive charge at the nucleus. The electrons pack themselves closely to the nucleus, which leads to a decrease in the atomic radius.

Anions have more electrons than their neutral atoms. Because there are more electrons, repulsion within that ion is high. The repulsion between electrons cause the electrons to spread out as far away from each other as possible. The spreading of the electrons within the orbital increases the atomic radius.

Lanthanide Contraction

Lanthanide contraction decreases the atomic radii starting from the lanthanide series. The decrease in atomic radii is due to the poor shielding of the 4f electrons.

References


Outside Links

- Quantum Numbers
- Electron Shielding

Problems

1.) What does the size of the orbital depend on?

2.) Which one is bigger?
   a.) Li b.) K c.) Rb d.) Fr

3.) Which one is bigger and why?
   a.) Ca b.) Ni c.) Zn d.) Cr

Answers

1.) Going down a group, it depends on how large "n" is. Going across a period, it depends on how closely the electrons
are attracted to the nucleus.

2.) d.) Fr--simply follow the periodic trend as stated in Problem 1.

3.) a.) Ca because compared to the others, it has the least amount of electrons meaning that they aren't packed closely to the nucleus increasing its size.

Contributors

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