Non Sibi High School

Andover's Chem 300: Accelerated/Honors Chemistry

Chapter 8, Review Quiz 1 Answers

1

Rank each group of atoms and ions from smallest to largest radius:

a. N, O, P^{3-}, P
b. Ca, K, Mg^{2+}, Mg
c. Br^{-}, Rb^{+}, Se^{2-}, Sr^{2+}

a. For neutral atoms, closest to upper right corner of periodic table = smallest atomic radius, so neutral atoms are ranked O < N < P. Neutral atoms will be smaller than anions of the same element, so P < P^{3-}. Therefore, the final ranking will be O < N < P < P^{3-}.

b. Neutral atoms are ranked Mg < Ca < K. Neutral atoms will be larger than cations of the same element, so Mg^{2+} < Mg. Therefore, the final ranking will be Mg^{2+} < Mg < Ca < K.

c. All are isoelectronic with 36 electrons. More protons = greater effective nuclear charge = smaller ionic radius, so from smallest to largest we have:

$$Sr^{2+}(38\,\mathrm{p}) < Rb^{+}(37\,\mathrm{p}) < Br^{-}(35\,\mathrm{p}) < Se^{2-}(34\,\mathrm{p})$$

2

Rank Ar, Ba, Cl, and Cs from smallest to largest atomic radius and lowest to highest first ionization energy.

Closest to the upper right corner of the periodic table = smallest atomic radius = highest first ionization energy. Therefore, from smallest to largest atomic radius we have Ar < Cl < Ba < Cs, and from lowest to highest first ionization energy we have the opposite order, Cs < Ba < Cl < Ar.

3

Explain the huge increase in ionization energy between I_4 and I_5 for carbon.

Carbon has the complete electron configuration $\underline{1}s^2 2s^2 2p^2$. The ionization energies will increase gradually from I_1 through I_4 as the two valence 2p electrons and then two valence 2s electrons are removed, but then I_5 will be enormous compared to I_4 as the 5th electron removed from carbon comes from the non-valence 1s orbital and, thus, requires a huge amount of energy for removal.

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