

Answer on the question #54655 – Chemistry – General chemistry

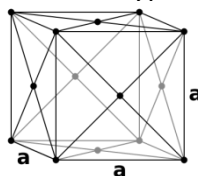
Question:

State the reason for the following: (10)

- (i) HI has more covalent character than HCl.
- (ii) Ionic compounds are more soluble in water than benzene.
- (iii) The radius of S^{2-} ion is larger than the radius of Cl^-
- (iv) In NaBr crystal, each ion is octahedrally surrounded by ions of opposite charge.
- (v) In HF, the experimental bond length value is less than the sum of covalent radii.

Answer:

- (i) Bond character is largely dependent on the difference in the degree of affinity to electron of both atoms. This property is largely dependent on the element position in the Periodic table. Let's compare the position of Cl and I in the table. One can see that they are situated in the same group, but Cl is in the 3d period, and I is in the 5th period. As the number of the period increases, the distance of the outer electron shell is increasing, that leads to weaker attraction of the electron by nucleus and therefore lower electron affinity.
- (ii) The main rule of solubility is that the polar substances tend to dissolve in polar solvents and nonpolar substances are dissolved in nonpolar solvents. As we know, that water is polar, then ionic (limit polar) compounds are more soluble than benzene (zero dipole moment, nonpolar liquid).
- (iii) Let's look the position of S and Cl elements in Periodic table. One can see that they belong to the same period but different groups: 6th and 7th, respectively. The first fact proves the same number of electrons for S^{2-} and Cl^- anions. But the nucleus charge of sulfur element is less than chlorine. That means that the force of attraction between the electron shell and nucleus is less for sulfur. Thus, the electron shell of sulfur anion is more diffuse, the radius is larger.
- (iv) The crystal lattice of NaBr is of face-centered type:



In this structure, each atom has 8 neighbors. According to the main law that charges of the opposite sign attract each other, these 8 neighbors are ones of the charge opposite to the central ion. In other words, the ion is surrounded by 8 ions of the opposite charge.

- (v) Ideally, the sum of the covalent radii is the covalent bond length between atoms. For heteroatomic molecules (molecules with different types of atoms) the ionic terms may enter, as the polarity of the atoms is different. The larger the difference in polarity of the atoms, the larger the role of ionic character of the bond. HF is polar molecule. Typically, the polar covalent bonds, like H–F, are shorter than expected from the sum of covalent radii.