

Answer on the question #54597 – Chemistry – General chemistry

Question:

What is understood by hydrogen bonding? How does hydrogen bonding? How does hydrogen bonding affect the properties of compounds? How many types of hydrogen bonding are there?

Answer:

Hydrogen bonding is a special type of chemical bonding inside the molecule or between different molecules with the participation of hydrogen atom. When the hydrogen bonding occurs, hydrogen atom is chemically linked to two (or more) atoms of other elements. This definition means, that the hydrogen atom can't be linked by two covalent bonds, as hydrogen has only one orbital (1s).

Presence of hydrogen bonding can be evinced as rising of melting and boiling points of the substance, such as NH_3 , H_2O or HF , comparatively to the temperatures, extrapolated from the respective values for the relative compounds (e.g. for HF – from the values for HCl , HBr and HI). On the molecular level, existence of hydrogen bonding causes the decrease in the interatomic distance comparatively to the sum of the values of Van-der-Waals radii.

Typically, the hydrogen atom is linked to the two electronegative elements. Usually such a system is linear, and hydrogen atom is closer to one atom (two-site covalent bonding) and more far from another (hydrogen bonding). Nevertheless, there are systems with equivalent bonding strength to the both atoms, e.g. $[\text{F}-\text{H}-\text{F}]^-$.

Hydrogen bonding is typically weaker than bonding in ionic crystals, but stronger than intermolecular interaction in molecular crystals that consist of non-polar and slightly polar molecules. It was noted that the formation of hydrogen bonding strengthen the structure of molecular crystals, e.g. solid organic compounds with amidic and carboxylic groups. Contrarily, in ionic crystals, hydrogen bonding weakens the structure, spacing ions in the lattice one from another (e.g., crystallohydrates).

Among the types of hydrogen bonding, one can distinguish intramolecular and intermolecular hydrogen bonding. The former is the one that occurs within the one single molecule. This case is possible only when both hydrogen donor and hydrogen bond acceptor are present in this molecule. Respectively, the latter is the one that occur between separate molecules in a substance. These molecules can be unlike and finally constitute a specific structural organization of the liquid or solid.