

Types of Intermolecular Forces

Target – Today I will be able to distinguish between the four different types of intermolecular forces. I will be able to determine what types of IMFs exist for a specific molecule. Pg. 173

There are four types of intermolecular forces that chemists have observed. As you can imagine, some are stronger than others.

1. London Dispersion (aka dispersion forces): the intermolecular attractions resulting from the constant motion of electrons and the creation of instantaneous dipoles.
 - a. Weakest IMFs
 - b. Present between all molecules.
 - c. Occur due to electrons of one molecule being weakly attracted to the positive nucleus of nearby atoms in another molecule.
 - d. For non-polar molecules, these are the only IMFs
 - e. Because electrons are not held in a fixed position) even though we draw them that way), electron density could be momentarily shifted to expose the nucleus to nearby electrons, thus causing a weak attraction.
 - f. Example online.
2. Dipole-Dipole forces: the attraction due to an uneven distribution of charge known as a dipole.
 - a. Dipole-dipole molecules are the next strongest IMF, but they are still rather weak.
 - b. Occurs only in polar molecules, which by definition have an uneven distribution of charge.
 - c. These dipole-dipole IMFs have to do with the electronegativity differences between two atoms in a polar bond. Remember that electronegativity is a measure of the ability of an atom to attract electrons.
 - d. Ex: Ammonia, NH_3
 - e. How to determine the presence of a dipole.
 - i. We use the lowercase delta to indicate “partial.”
 - ii. When determining whether a molecule is polar or not, you can draw a vector in the direction of the most electronegative atom. These are vectors that can help you determine polarity. If the vectors cancel, the molecule is non polar.
 - iii. Hint: linear and tetrahedral molecules with the same substituent on each bond are never polar.
3. Hydrogen bonding: the IMF in which a hydrogen atom that is bonded to a highly electronegative atom in a nearby molecule. *Note: this is not truly a bond, but rather an IMF, albeit a very strong one.*
 - a. Occur in when hydrogen bonds with F, O, N
 - i. Hint: “H-bonds are really F.O.N!”
 - b. The strongest type of purely IMF

- c. Like the dipole IMF, the hydrogen bond has to do with very large differences in the Electronegativity differences between H and F, O, or N.
 - d. They create a very strong dipole between individual molecules.
 - e. Ex: water. Show how the LPE attracts the relatively positive hydrogen.
4. Ionic forces are interactions between charged atoms or molecules.
- a. Are the strongest type of IMFs
 - b. Exist only for ionic compounds,
 - c. Because in ionic bonding, there is an electron transfer, one substance has a negative charge and one has a positive charge. The negative ions are surrounded by valence electrons and the positive ions are free of any valence electrons. Thus, the atoms pack tightly together in a crystal lattice structure. The ionic bond between atoms becomes equivalent to the ionic forces between molecules.
 - d. This is the reason our ionic compounds on our lab had such high melting points. Because these IMF are as strong as the bonding forces that exist in these structures.
 - e. Ex: NaCl crystal lattice structure.