Chemistry 20

Lessons 1 to 14 Review

Notes

Why do chemical bonds form?

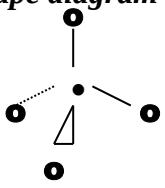
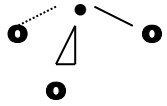
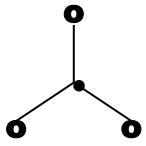
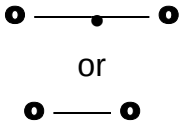
- A chemical bond will form if a molecule is more stable than the isolated atoms from which it is formed.
- A bond is formed due to the simultaneous attraction for the electrons of one atom by the nucleus of another atom.

Intramolecular bonding - bonding within molecules

1. **Covalent Bonds** - unpaired valence electrons are shared between 2 nuclei in order to obtain a stable structure.
   a) single covalent bond - 1 pair of electrons are shared
   d) double covalent bond - 2 pairs of electrons are shared
   c) triple covalent bond - 3 pairs of electrons are shared
   - If the electronegativities of the two atoms are the same, the bond between them will be a **non-polar covalent** bond.
   - If the electronegativities are different, the bond will be **polar covalent**.

Shapes of molecules:

Draw the Lewis diagram for the molecule and count the lone pairs and bonding groups around the central atom. Using the table, one may determine the shape of the molecule:

Situation around the central atom		***Shape name***	***Shape diagram***
LP	***BP***		
0	4	tetrahedral	
1	3	pyramidal	
2	2	V shaped	
0	3	trigonal planar	
0	2	linear	

2. **Ionic Bonds** - are very polar bonds which occur if the difference in electronegativities exceeds 1.7.
    - Occurs between metals and non-metals.
    - Ionic compounds exist as crystalline lattices with no distinct molecules.
    - Formed from the <u>exchange</u> of electrons:

Intermolecular forces - forces <u>between</u> molecules

1. **London dispersion forces**
    - Exist between all molecules.
    - Weak force of attraction from the nuclei of one molecule for the electrons of a different molecule.
    - The greater the number of electrons, the greater the dispersion forces. (generally)
    - The larger the molecule, the greater the dispersion forces. (generally)
    - The greater the dispersion forces, the higher the boiling point of the substance. (generally)
2. **Dipole-dipole forces**
    - Occurs <u>only</u> between polar molecules.
    - Negative end of one molecule will attract the positive end of a different molecule.

(+ -) (+ -) (+ -) (+ -) (+ -)
(- +) (- +) (- +) (- +) (- +)
(+ -) (+ -) (+ -) (+ -) (+ -)

<u>Solubility</u>
- Tends to follow the rule that "like dissolves like".
    - Polar substances dissolve polar substances.
    - Non-polar substances dissolve non-polar substances.
    - Polar and non-polar do not dissolve well together.

3. **Hydrogen Bonding**
    - Hydrogen bonds are the result of dipole-dipole interactions between a highly electronegative atom (F, O, N) and a hydrogen atom. The "naked" positive charge of the hydrogen atom will bond with the negatively charged atom of a different molecule.

Energy Changes in Reactions
- A chemical reaction will occur in the direction of least energy. If the products formed have a lower more stable energy state than the reactants, the reaction will occur.
- A reaction may be accompanied by a release of energy (*exothermic*) or an absorption of energy (*endothermic*).

Questions

For each of the following substances, draw the Lewis dot, structural, and shape diagrams for the molecule and identify the molecule as polar or non-polar.

1. $BrF_{(g)}$

2. $CH_3CI_{(g)}$

3. $C_2Br_{4\ (s)}$

4. $NCl_{3\ (l)}$

5. List the intermolecular bonding forces present in ethanol.

Consider the substances C_2H_3CI and C_2H_3I when answering the next three questions.

6. Which of the substances, C_2H_3CI and C_2H_3I, would probably be more polar?

7. Which would probably have the higher boiling point?

8. What specific type of bonding probably contributes most to the intermolecular attractions in these substances?

9. In which of the following does repulsion from a lone pair not influence molecular shape?

   A. H_2S B. NI_3 C. HBr D. OF_2 E. PH_3

10. The Organic Chemistry unit will provide information about the molecular compound benzene, C_6H_6 . The boiling points for some benzene compounds are:

    C_6H_5F: 85 ^oC C_6H_5Cl:132 ^oC C_6H_5I: 188 ^oC

    Which of the following is the boiling point for C_6H_5Br?

    A. 98 ^oC B. 122 ^oC C. 156 ^oC D. 249 ^oC E. 337 ^oC

11. Phenol, C_6H_5OH (182 ^oC) has a boiling point very close to that of iodobenzene, C_6H_5I (188 ^oC).

    List, the bond types contributing to the Intermolecular attractions in each substance. Explain why it is not possible to confidently predict which has the higher boiling point.

12. Arrange the following substances in order of increasing boiling points. List beside each substance the type of bonding present in the solid state. For the molecular substances, also list the number of electrons per molecule and note whether any of the substances are isoelectronic.

C_8H_{18} $C_3H_5(OH)_3$ C_6H_{14} C_4H_9Cl NaF

13. Arrange the following from highest to lowest boiling point.

F_2 HCl CH_3OH C_2H_6 H_2O_2

14. Complete the following statement.

All chemical bonds result from...

15. If 2.0 g of ethane (C_2H_6) is burned, what mass of water vapour is produced?

16. Sodium chloride is decomposed using electrolysis. What mass of sodium chloride is decomposed to produce 1.35 kg of chlorine gas?

17. The following observations were recorded when some copper wire was immersed in a concentrated solution of silver nitrate.

initial mass of copper ..... 3.68 g
final mass of copper ..... 0.49 g

What mass of silver is produced?