

ATOMIC COMBINATIONS: MOLECULAR STRUCTURE

11 MARCH 2014



Lesson Description

In this lesson we:

- Identify and describe the shape of molecules
- Discuss intermolecular forces
- Discuss how intermolecular forces affect the physical properties of substances



Summary

Types of Chemical Bonds

Covalent Bond

When two non-metals bond together a covalent bond is formed. This bond is characterised by the electrons involved in the bond being shared between the two atoms involved.

Ionic Bond

When a non-metal and a metal bond, an ionic bond is formed. This bond is characterised by the electron from the metal being transferred to the non-metal. This creates positive and negative ions which are then electrostatically attracted to one another.

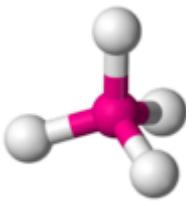
Metallic Bond

Metallic bonds are found in metals as elements and alloys. This bond is characterised by the positive atomic core surrounded by sea of delocalised electrons.

Shapes of Molecules

Covalently bonded molecules have characteristic shapes which are determined by the number of atoms involved, the number of bonding pairs of electrons and the number of lone pairs (electrons pairs not involved in the bonding)

Shape	Diagram	Electron pairs	Examples
Linear		1 bonding pair	HCl
Linear		2 or 4 bonding pairs No lone pairs	CO_2
Angular		2 bonding pairs 2 lone pairs	H_2O
Pyramidal		3 bonding pairs 1 lone pair	NH_3

Tetrahedral		4 bonding pairs	CH ₄
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Intermolecular Forces

The forces that keep molecules together in solid, liquid or gas phase are known as intermolecular forces. Specifically these forces are called **Van Der Waal's** forces. The strength of these forces determines the physical properties of substances such as boiling point, melting point, viscosity, surface tension and density

Important Terms

Boiling point: The boiling point is the temperature at which the vapour pressure is equal to the atmospheric pressure.

Melting point: The temperature at which a solid becomes a liquid

Viscosity: Viscosity is an indication of a liquid's resistance to flow

Surface tension: Surface tension is due to the cohesive forces of molecules on the surface of a volume of a liquid.

Density: Density is the number of particles per unit volume

When the intermolecular forces between molecules of a substance are relatively strong, the substance will have a high melting point, boiling point, viscosity, surface tension and density.



Test Yourself

Question 1

What type of chemical bonds are present in a molecule of ammonia (NH₃)?

- A ionic bonds
- B non-polar covalent bonds
- C polar covalent bonds
- D dative covalent bonds

Question 2

What shape best describes a molecule of ammonia (NH₃)?

- A linear
- B tetrahedral
- C pyramidal
- D planar

Question 3

What forces are present between molecules of ammonia (NH_3) gas?

- A ion –ion forces
- B non-polar – non-polar
- C London forces
- D hydrogen bonds

Question 4

Select the substance which has the highest boiling point

- A hydrogen
- B hydrogen chloride
- C hydrogen sulphide
- D water

Question 5

How many bonding pairs and lone pairs are present in a water molecule

- A 2 bond pairs and 2 lone pairs
- B 2 bond pairs and 1 lone pair
- C 1 bond pair and 2 lone pairs
- D 1bond pair and 1 lone pair



Improve your Skills

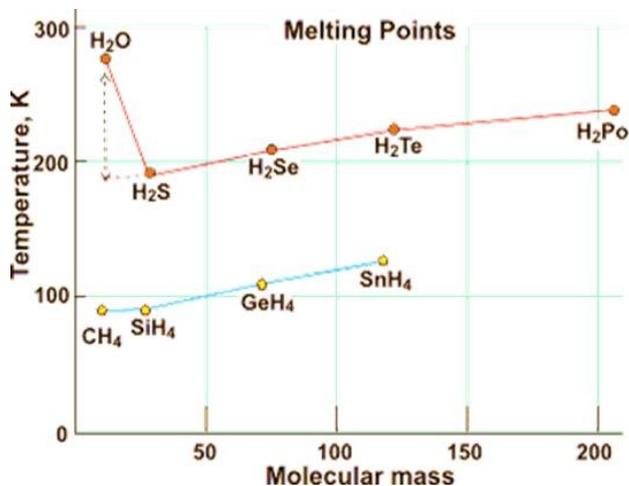
Question 1

Determine the shape of the following compounds

- a) Methane (CH_4)
- b) Ethane (C_2H_6)
- c) Ethene (C_2H_4)
- d) Ethyne (C_2H_2)

Question 2

Consider the following graph and explain the trend in the melting points of the compounds.



Question 3

Consider the substances below and answer the questions which follow:

CO_2 (g), CCl_4 (l), CH_4 (g), HCl (g), C (s), NH_3 (g)

- Give the Lewis structure for CCl_4 .
- According to the VSEPR theory, what shapes will the CCl_4 and CO_2 molecules have respectively?
- Name the intermolecular force found between the CH_4 molecules.
- Identify the gaseous substances which have polar covalent bonds between the atoms, but the molecule as a whole is non-polar. Explain your answer
- Which substance has the strongest covalent bonds between the atoms?
- Which substance has the strongest intermolecular forces?