

UNIT 13 BONDING, MOLECULAR STRUCTURE, IMF's and STATES OF MATTER

Textbook References: *Chemistry* Zumdahl 5th Edition Chapters 8, 9 & 10

1. describe ionic, metallic and covalent bonds
2. distinguish between ionic, polar covalent and nonpolar covalent bonds
3. use the strength of ionic bonds to compare the properties of ionic compounds
4. draw dot diagrams for covalent compounds and polyatomic ions
5. determine structural and molecular shapes of covalent compounds using VSEPR
6. determine the type of hybrid orbitals used in covalent bonding
7. determine the molecular polarity of a covalent compound
8. determine the number of sigma and pi bonds in a molecule
9. determine if a covalent molecule has resonance structure and draw the resonance structures
10. determine bond order and compare bond strength and length for covalent molecules
11. use bond energies to estimate the heat of reaction
12. use formal charge to determine the more important resonance structure for covalent molecules
13. list and describe the types of intermolecular forces
14. state the type of particles that display each type of intermolecular force
15. given the formulas of the substances determine the type of inter-particle force and compare their relative strength
16. use the relative strength of the inter-particle force to determine the magnitude of each of the following properties of different substances: surface tension, vapor pressure, viscosity, capillary action, boiling point, melting point, critical temperature
17. interpret phase diagrams
18. determine the amount of heat required for change in temperature or state
19. list the types of solids and distinguish between each type on basis of lattice points and the forces between the lattice points

Vocabulary:

inter molecular forces
evaporation
condensation
melting/ freezing point
boiling point
vapor pressure
heat of vaporization
heat of fusion
equilibrium
enthalpy
entropy
critical point
triple point
amorphous solid
phase diagram

critical pressure
critical temperature
cohesive forces
adhesive forces
surface tension
viscosity
meniscus
capillary action
lattice point
crystalline solid
ionic bond
electronegativity
covalent bond
polar covalent bond
nonpolar covalent bond
dipole

octet rule
VSEPR
structural pair geometry
molecular geometry
resonance structure
bond order
bond length
bond energies
formal charge
metallic bond
sigma bond
pi bond
coordinate covalent bond
hybrid orbitals
lattice points

AP Course Guide correlation:

I. Structure of Matter

B. Chemical bonding

1. Binding forces

a. Types: ionic, covalent, metallic, hydrogen bonding, van der Waals (including London dispersion forces)

b. Relationships to states, structure, and properties of matter

- c. Polarity of bonds, electronegativities
- 2. Molecular models
 - a. Lewis structures
 - b. Valence bond: hybridization of orbitals, resonance, sigma and pi bonds
 - c. VSEPR
- 3. Geometry of molecules and ions, structural isomerism of simple organic molecules and coordination complexes; dipole moments of molecules; relation of properties to structure
- II. States of Matter
 - B. Liquids and solids
 - 1. Liquids and solids from the kinetic-molecular viewpoint
 - 2. Phase diagrams of one-component systems
 - 3. Changes of state, including critical points and triple points
 - 4. Structure of solids; lattice energies

IB Course Outline correlation:

- 4.1.1 Describe the ionic bond as the electrostatic attraction between oppositely charged ions.
- 4.1.2 Describe how ions can be formed as a result of electron transfer.
- 4.1.3 Deduce which ions will be formed when elements in groups 1, 2 and 3 lose electrons.
- 4.1.4 Deduce which ions will be formed when elements in groups 5, 6 and 7 gain electrons.
- 4.1.5 State that transition elements can form more than one ion.
- 4.1.6 Predict whether a compound of two elements would be ionic from the position of the elements in the periodic table or from their electronegativity values.
- 4.1.7 State the formula of common polyatomic ions formed by nonmetals in periods 2 and 3.
- 4.1.8 Describe the lattice structure of ionic compounds.
- 4.2.1 Describe the covalent bond as the electrostatic attraction between a pair of electrons and positively charged nuclei.
- 4.2.2 Describe how the covalent bond is formed as a result of electron sharing.
- 4.2.3 Deduce the Lewis (electron dot) structures of molecules and ions for up to four electron pairs on each atom.
- 4.2.4 State and explain the relationship between the number of bonds, bond length and bond strength.
- 4.2.5 Predict whether a compound of two elements would be covalent from the position of the elements in the periodic table or from their electronegativity values.
- 4.2.6 Predict the relative polarity of bonds from electronegativity values
- 4.2.7 Predict the shape and bond angles for species with four, three and two negative charge centres on the central atom using the valence shell electron pair repulsion theory (VSEPR).
- 4.2.8 Predict whether or not a molecule is polar from its molecular shape and bond polarities.
- 4.2.9 Describe and compare the structure and bonding in the three allotropes of carbon (diamond, graphite and C₆₀ fullerene).
- 4.2.10 Describe the structure of and bonding in silicon and silicon dioxide.
- 4.3.1 Describe the types of intermolecular forces (attractions between molecules that have temporary dipoles, permanent dipoles or hydrogen bonding) and explain how they arise from the structural features of molecules.
- 4.3.2 Describe and explain how intermolecular forces affect the boiling points of substances.
- 4.4.1 Describe the metallic bond as the electrostatic attraction between a lattice of positive ions and delocalized electrons.
- 4.4.2 Explain the electrical conductivity and malleability of metals.
- 4.5.1 Compare and explain the properties of substances resulting from different types of bonding.
- 14.1.1 Predict the shape and bond angles for species with five and six negative charge centres using the VSEPR theory.
- 14.2.1 Describe σ and π bonds. orbitals
- 14.2.2 Explain hybridization in terms of the mixing of atomic orbitals to form new orbitals for bonding.

14.2.3 Identify and explain the relationships between Lewis structures, molecular shapes and types of hybridization (sp, sp² and sp³).

14.3.1 Describe the delocalization of π electrons and explain how this can account for the structures of some species.

17.1.1 Describe the equilibrium established between a liquid and its own vapour and how it is affected by temperature changes.

17.1.2 Sketch graphs showing the relationship between vapour pressure and temperature and explain them in terms of the kinetic theory.