

Unit 4- Chemical Bonding

PS-4 Chemical Bonding – Atoms combine through the redistribution of electrons producing compounds. By understanding the nature of chemical bonding students are able to predict properties, interactions and reactivity of many substances.

TS-4.1 Ionic bonding- Ionic compounds (salts) are formed through the transfer of electrons from less electronegative elements to more electronegative elements

4.1.1 Explain how elements form ions through the loss (oxidation) or gain (reduction) of electrons.

Key Ideas: Octet rule, cation, anion, monatomic ion, polyatomic ion, oxidation/reduction (Redox)

4.1.2 Determine the charge of the ion of elements based on the relative position on the periodic table and their electron configurations

Key Ideas: Lewis-dot diagram (electron-dot diagram), single vs. multiple oxidation states

4.1.3 Predict formulas for ionic compounds

Key Ideas: Percent composition, formula mass, Law of definite proportions, Law of multiple proportions

4.1.4 Determine names for ionic compounds given chemical formulas

TS-4.2 Covalent bonding- Molecules are composed of atoms that share electrons by overlapping valence shells

4.2.1 Explain how electrons are shared in covalent bonding

4.2.2 Determine names for covalent compounds given molecular formulas

Key Ideas: empirical, molecular & structural formulas

4.2.3 Determine Lewis structures given molecular formulas

Key Ideas: bond pairs vs. lone pairs, octet rule exceptions—expansion & contraction,

4.2.4 Differentiate between types of covalent bonds based on the number of shared electrons

Key Ideas: Single, double & triple covalent bonds,

4.2.5 Use VSEPR theory to describe molecular structures and polyatomic ions

4.2.5.1 Describe the hybridization of atomic orbitals and their distribution in space around a central atom using the following types of hybridization: sp, sp² & sp³ hybridization

4.2.5.2 Differentiate sigma vs. pi bonding based on bonded electron distribution and describe energy & strength differences.

4.2.5.3 Describe how hybridization occurs in octet expansion—sp³d & sp³d²

4.2.6 Draw geometric (structural) formulas using VSEPR

4.2.7 Describe bond polarity in terms of differences in electronegativity

4.2.8 Describe dipole moments (polar molecules) using bond polarities and geometric formulas

Key Ideas: dipole/dipole, hydrogen bonds, ion/dipole, London dispersion forces

4.2.9 Describe how intermolecular attractions (van der Waals forces) between molecules affect physical properties

TS 4.3 Metallic bonding- Metal atoms are combined through delocalized electrons which form temporary electrostatic attractions

4.3.1 Describe the nature of metallic bonds

Key Ideas: delocalized electrons, alloys

TS 4.4 Comparing bonds and compounds- Physical properties of different compounds are dependent upon the types of bonds which form them.

4.4.1 Describe bonding using electronegativity differences between elements

Key Ideas: Ionic, nonpolar covalent, polar covalent

4.4.2 Compare and contrast the physical properties of ionic, covalent, and metallic compounds

Key Ideas: melting & boiling points, solubility, conductivity