

KARACHI EDU • COACHING CENTER NOTES

Chapter 4: Chemical Bonding

Detailed notes covering octet rule, ionic, covalent, coordinate covalent, metallic bonds, and intermolecular forces.

Why Do Atoms Form Chemical Bonds?



Desire for Stability

Atoms share, gain, or lose electrons to achieve stable noble gas electronic configuration.



Duplet & Octet Rules

Duplet rule achieves 2 valence electrons; octet rule achieves 8 electrons in valence shell.



Inert Noble Gases

Elements like He, Ne, and Ar possess fully filled valence shells and rarely form chemical bonds.

CLASSIFICATION

Types of Chemical Bonds

01

Ionic Bond

Complete transfer of valence electrons from metal to non-metal creating oppositely charged ions.

02

Covalent Bond

Mutual sharing of electron pairs between non-metal atoms (single, double, or triple bonds).

03

Coordinate Covalent

Dative bond formed by donating a complete lone pair of electrons from one atom to another.

Formation of Sodium Chloride (NaCl)

Sodium Atom (Na)

Electronic configuration: 2, 8, 1.

Loses 1 valence electron to form stable sodium cation
(Na^+ : 2, 8).

Chlorine Atom (Cl)

Electronic configuration: 2, 8, 7.

Gains 1 valence electron to form stable chloride anion
(Cl^- : 2, 8, 8).

Electrostatic Attraction

Oppositely charged ions attract each other strongly.

Forms crystal lattice structure with high melting point
(801°C).

Magnesium Oxide (MgO) Formation

Magnesium Transfer

Mg (group IIA) loses 2 electrons to form Mg^{2+} ion (2, 8 configuration).

Oxygen Acceptance

Oxygen (group VIA) gains 2 electrons to form O^{2-} ion (2, 8 configuration).

Higher Bond Strength

Greater charge density (Mg^{2+} and O^{2-}) yields exceptionally high melting point.

Single, Double & Triple Covalent Bonds

Single Bond (–)

Mutual sharing of 1 electron pair.

Examples: Cl_2 ,
 HCl , CH_4 .

Double Bond (=)

Mutual sharing of 2 electron pairs.

Examples: O_2 ,
 C_2H_4 .

Triple Bond ($\equiv$)

Mutual sharing of 3 electron pairs.

Example: Nitrogen molecule
(N_2).

Coordinate Covalent (Dative) Bonding

Definition

A covalent bond where the shared electron pair is donated by only one of the participating atoms (donor atom).

Ammonium Ion (NH_4^+)

Formed when lone pair on nitrogen in ammonia (NH_3) coordinates with hydrogen ion (H^+).

Hydronium Ion (H_3O^+)

Water molecule donates a lone pair to H^+ ion, forming hydronium ion in aqueous solutions.

Metallic Bonding & Delocalized Electrons

Positive Metal Ions

Metal atoms lose valence electrons and occupy fixed positions in a crystal lattice.

Mobile Sea of Electrons

Outer shell electrons move freely between metal ions as delocalized electrons.

Properties

Explains high electrical/thermal conductivity, malleability, and ductility of metals.

Dipole–Dipole Interactions & Hydrogen Bonding

Dipole–Dipole Interaction

Electrostatic attraction between partial positive (δ^+) and partial negative (δ^-) ends of polar molecules like HCl .

Hydrogen Bonding

Special strong dipole interaction when H is covalently bound to highly electronegative atoms (N, O, F).

Biological Significance

Crucial for water properties, protein folding, DNA double helix structure, and synthetic resins.

Ionic vs. Covalent Compounds

Ionic Compounds

- Hard crystalline solids
- High melting and boiling points
- Conduct electricity in aqueous/molten state

Covalent Compounds

- Exist as gases, liquids, or soft solids
- Low melting and boiling points
- Poor electrical conductors in solution

Key Takeaways for KARACHI EDU Students

Octet Achievement

Atoms react to attain stable noble gas electron configurations.

Electron Transfer

Ionic bonding involves complete transfer between metals and non-metals.

Electron Sharing

Covalent and coordinate bonds rely on electron pair sharing.

Intermolecular Forces

Hydrogen bonding and dipole forces dictate physical states and properties.

Questions & Discussion

KARACHI EDU Coaching Center — Chemistry Department IX
