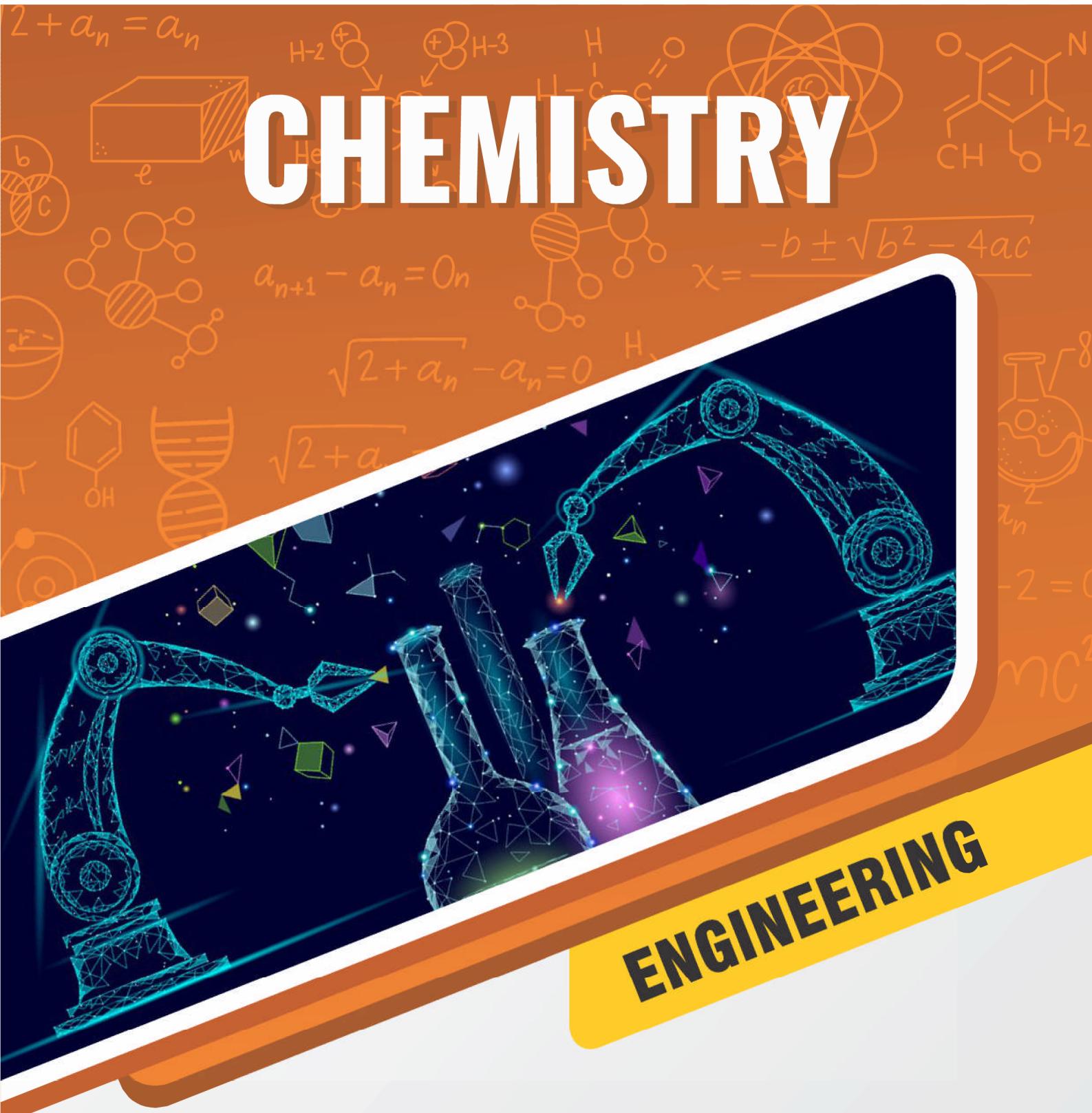


CHEMISTRY



CHEMICAL BONDING



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CHEMICAL BONDING

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CHEMICAL BONDING

INTRODUCTION

- (i) Most of the elements exist as molecules which are cluster of atoms. How do atoms combine to form molecules and why do atoms form bonds. Such doubts will be discussed in this chapter.
- (ii) A molecule will only be formed if it is more stable and has a lower energy, than the individual atoms.

CHEMICAL BOND

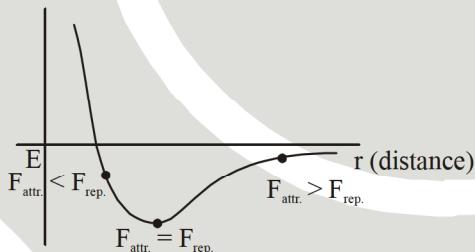
- (i) A force that acts between two or more atoms to hold them together as a stable molecule.
- (ii) It is union of two or more atoms involving redistribution of electron among them.
- (iii) This process accompanied by decrease in energy.
- (iv) Decrease in energy \propto Strength of the bond.
- (v) Therefore molecules are more stable than atoms.

CAUSE OF CHEMICAL COMBINATION :

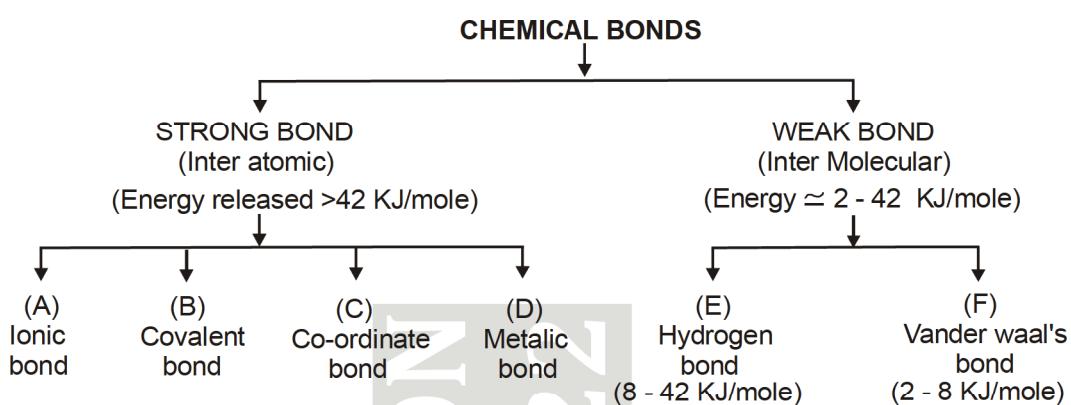
1. Tendency to acquire noble gas configuration : (classical concept)

- (i) Atoms combine to acquire noble gas configuration.
- (ii) Only outermost electrons i.e. ns, np and (n-1)d electrons participate in bond formation.
- (iii) Inert gas elements do not participate, as they have stable electronic configuration and hence minimum energy. (Stable electronic configuration : $1s^2$ or ns^2np^6)

2. Tendency to acquire minimum energy :(modern concept)



- (i) When two atoms approach to each other, nucleus of one atom attracts the electrons of another atom.
- (ii) Two nuclei and electron of both the atoms repel each other.
- (iii) If net result is attraction, the total energy of the system (molecule) decreases and a chemical bond forms.
- (iv) So, Attraction \propto 1/energy \propto Stability.



1. OCTET RULE (LEWIS-KOSSEL RULE)

Noble gases have 8 electron in their outermost shell (complete octet) and outermost configuration is ns^2p^6 . Every atom has a tendency to complete its octet by losing or gaining or by sharing electrons.

Three different types of bonds—ionic, covalent, and metallic—are formed depending on the electropositive or electronegative character of the atoms (of an element) involved in a bond formation. Atoms of various elements may be electropositive or electronegative depending on the type of element. Elements may be classified as follows:

- (i) Electropositive elements. These elements readily lose one or more electrons.
- (ii) Electronegative elements. These elements accept electrons and achieve a stable electronic configuration.
- (iii) Elements that have a little tendency to lose or gain electrons.

ELECTRON-DOT (LEWIS) STRUCTURE

For single central atom Lewis structure drawing

Rules for Lewis Structure Drawing :

- (i) Calculate $n_1 = \text{no. of valence shell electrons of all atoms} + \text{no. of negative charge (if any)} - \text{no. of positive charge (if any)}$
- (ii) Calculate $n_2 = (\text{no. of H-atom} \times 2) + (\text{no. of atoms other than H-atoms} \times 8)$
- (iii) Calculate $n_3 = n_2 - n_1 \Rightarrow \text{no. of shared electrons}$
i.e. No. of bonds = $\frac{n_3}{2}$ (a)
- (iv) Calculate $n_4 = n_1 - n_3 \Rightarrow \text{no. of unshared electrons}$
i.e. no. of lone pairs = $\frac{n_4}{2}$ (b)

Using the informations (a) & (b) the structure is to be assigned as follows:

- Find out the central atom first (i.e. either least in number or more electro positive)
- Allocate the surrounding atoms around the central atom with the help of bonds available in (a).
- To fulfill the octet of each atom, utilise the lone pairs available in (b).
- Finally calculate the formal charge for each atom and assign on the atoms according the formula given.

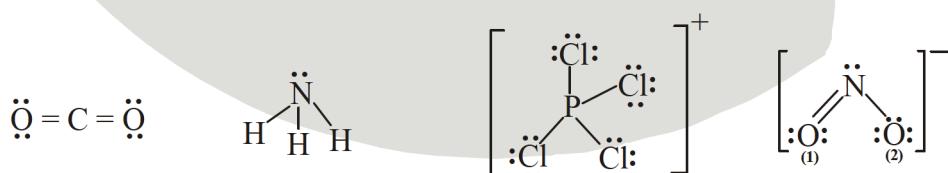
F.C. (of an atom) = Valence shell electron of that atom

- no. of bonds associated with it
- no. of unshared electrons on it.

In order to write the Lewis structure of a molecule, the points given below need to be kept in mind.

- Add the valence electrons of all atoms. In case of an ion, add electrons equal to negative charge (for negative ion) or subtract the number of electrons equal to the positive charge (for a positive ion).
- Write the formula of the compound, and join atoms by single bonds.
- Complete the octet of all the atoms (or two electrons for hydrogen) which are bonded to the central atom.
- Fix up the remaining electrons, if any, on the central atom.
- In case the central atom does not have the requisite number of electrons to complete its octet, attach it by multiple bonds.

S.NO.	CO ₂	NH ₃	PCl ₄ ⁺	NO ₂ ⁻
1. n ₁	16	8	32	18
2. n ₂	24	14	40	24
3. n ₂ - n ₁ = n ₃	8	6	8	6
4. n ₃ /2	4	3	4	3
5. n ₃ - n ₁ = n ₄	8	2	24	12
6. n ₄ /2	4	1	12	6



Formal charge

$$C = \text{zero}$$

$$O = \text{zero}$$

$$N = \text{zero}$$

$$H = \text{zero}$$

$$P = +1$$

$$Cl = \text{zero}$$

$$N = \text{zero}$$

$$O(1) = \text{zero}$$

$$O(2) = -1$$