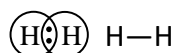


## Introduction

Carbon is most important element because it forms largest number of compounds which are useful in our daily life. In this chapter, we shall study about carbon and its compounds.

### Important Terms and Concepts :

1. **Carbon** : Its atomic number is 6. Its mass number is 12. Its atomic mass is 12.011. Its melting point is  $3550^{\circ}\text{C}$  and boiling point is  $4830^{\circ}\text{C}$ . It occurs in free state as well as in combined state. 70% of our body is made up of carbon. It forms largest number of compounds. The earth crust contains only 0.02% of carbon.
2. **Organic Compounds** : Those compounds which consist of carbon essentially and hydrogen mostly along with other elements like oxygen, sulphur, nitrogen, halogens, etc. are called organic compounds.
3. **Coal** : It is a naturally occurring solid fuel which exists in the form of varying depths below the earth's surface. It is formed by decay of vegetation that grew 40 to 300 million years ago, followed by chemical processes of condensation and polymerization under influence of temperature, pressure and time.
4. **Petroleum** : It is an oil found in rocks. It is a mixture of solid, liquid and gaseous hydrocarbons. It is a source of petrol, diesel, kerosene, petroleum ether, petroleum coke, petroleum wax, etc.
5. **Carbonates** : They are compounds of carbonic acid. They are found in earth crust, *e.g.*,  $\text{CaCO}_3$ ,  $\text{MgCO}_3$ ,  $\text{Na}_2\text{CO}_3$ ,  $\text{NaHCO}_3$ ,  $\text{ZnCO}_3$ . They are thermally stable.
6. **Hydrogen Carbonates** : They contain  $\text{HCO}_3^-$  ions. They are formed by replacing one  $\text{H}^+$  of carbonic acid, *e.g.*,  $\text{NaHCO}_3$ ,  $\text{Ca}(\text{HCO}_3)_2$ ,  $\text{Mg}(\text{HCO}_3)_2$ . They are soluble in water. They are thermally unstable, *i.e.*, decompose on heating to form carbonates,  $\text{CO}_2$  and  $\text{H}_2\text{O}$ .
7. **Chemical Bond** : It is a force of attraction which holds the two atoms together.
8. **Covalent Bond** : It is the bond formed by equal sharing of electrons, *e.g.*, Hydrogen has one valence electron. It can share one valence electron with other hydrogen atom to form  $\text{H}_2$  molecule so as to acquire nearest noble gas configuration. The bond between two hydrogen atoms by sharing one electron each is called covalent bond.
9. **Covalency of Carbon** : Carbon has four valence electrons. It cannot lose four electrons since very high amount of energy will be required to lose four electrons to form  $\text{C}^{4+}$  ion. There is strong force of attraction between nucleus and valence electrons.  
Carbon cannot gain four electrons to form  $\text{C}^{4-}$  ion because six protons cannot hold 10 electrons easily and there will be strong interelectronic repulsion.  
Carbon can share four electrons easily with other atoms of carbon and other elements to acquire stable electronic configuration.
10. **Hydrogen Molecule** : When two atoms of hydrogen share one electron each, a single covalent bond is formed as shown below



(Single covalent bond between two hydrogen atoms)

- 11. Chlorine Molecule :** Chlorine has 7 valence electrons. It can share one electron with other chlorine atom to form  $\text{Cl}_2$ .



(Single covalent bond between two chlorine atoms)

- 12. Single Covalent Bond :** It is a bond formed by sharing of one electron by each of the atoms. It is represented by a line between two atoms.

- 13. Hydrogen Fluoride :** When one hydrogen atom shares one electron with one electron of fluorine, hydrogen acquires two electrons whereas fluorine acquires 8 electrons and becomes stable. They form single covalent bond.

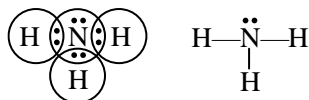


(Single Covalent bond between hydrogen and fluorine)

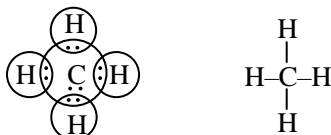
- 14. Water :** In formation of  $\text{H}_2\text{O}$ , each hydrogen atoms shares one electron with oxygen atom so that oxygen completes its octet and hydrogen acquires nearest nobles gas configuration.



- 15. Ammonia :** Nitrogen has five valence electrons. It shares one electron with each of the three hydrogen atoms to form  $\text{NH}_3$ .



- 16. Methane :** Carbon has four valence electrons. It needs four electrons to complete its octet. It shares four electrons with four hydrogen atoms and forms four single covalent bonds.



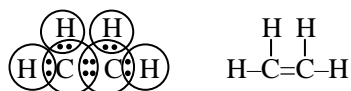
- 17. Double Covalent Bond:** When two atoms share two electrons each to acquire stable electronic configuration, double covalent bond is formed. It is denoted by = (two lines)

- 18. Oxygen Molecule :** When two oxygen atoms share two electrons each to complete their octet, double covalent bond is formed.



(A double covalent bond between two oxygen atoms)

- 19. Ethene ( $\text{C}_2\text{H}_4$ ) :** When two carbon atoms share two electrons with each other and each 'C' shares two electrons with two hydrogen atoms, they complete their octet and form double covalent bond between two carbon atoms. ☐



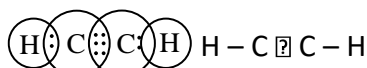
- 20. Triple Covalent Bond :** When an atom shares three valence electrons with each other or other atom, triple covalent bond is formed. It is denoted by ≡ (three lines)

- 21. Nitrogen :** Nitrogen has five valence electrons. It needs three more electrons to complete its octet. It shares three electrons with other atom of nitrogen to form triple covalent bond.

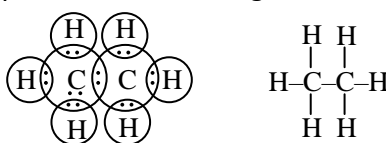


(Triple covalent bond between two nitrogen atoms)

- 22. Ethyne ( $\text{C}_2\text{H}_2$ ) :** When two carbon atoms share three electrons with each other and each carbon shares one electron with hydrogen atom, they complete their octet and form triple covalent bond with each other.



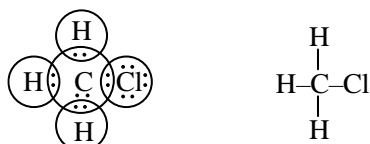
- 23. Ethane ( $\text{C}_2\text{H}_6$ ) :** In the ethane, two carbon atoms share one electron each forming single covalent bond with each other. Each carbon shares one electron with three hydrogen atoms to complete their octet, *e.g.*,



- 24. Carbon dioxide :** Carbon has four valence electron. It shares two electron with one of the oxygen and two electrons with other atom of oxygen to form double covalent bond.



- 25. Methyl chloride ( $\text{CH}_3\text{Cl}$ ) :** Carbon has four valence electrons. It shares one electron with chlorine atom and one electron with each of three hydrogen atoms forming four single bond.



- 26. Carbon tetrachloride ( $\text{CCl}_4$ ) :** Carbon shares one electron with each of four chlorine atoms forming four single covalent bonds.

