# Question Bank
# Chemical Bonding

**1.** Give one word/words for the statements given below :

**(a)** Arrangement of electrons around the nucleus of an atom. [1]

**(b)** A compound formed by the actual exchange of electrons from the valence shell of a metal to the valence shell of a non-metal. [1]

**(c)** An electrostatic bond between a metallic and a non-metallic ion.

**(d)** A bond formed between two non-metallic elements by mutual sharing of electrons. [1]

**(e)** A compound in which shared pair of electrons are unequally distributed between the reacting atoms. [1]

**(f)** A compound in which shared pair of electrons are equally distributed between the reacting atoms. [1]

**(g)** The process due to which an atom or an ion loses an electron/electrons. [1]

**(h)** The substance which loses an electron or electrons. [1]

**(i)** Weak electrostatic forces between the molecules of polar covalent compounds. [1]

**(j)** A chemical reaction in which gain and loss of electrons takes place simultaneously. [1]

**Ans.** **(a)** Electronic configuration **(b)** Ionic compound
**(c)** Ionic bond **(d)** Covalent bond
**(e)** Polar covalent compound
**(f)** Non-polar covalent compound
**(g)** Oxidation **(h)** Reducing agent
**(i)** Intermolecular forces **(j)** Redox reaction

**2.** Choose the correct word/words from the brackets to complete the sentences given below.

**(a)** In the formation of sodium chloride, the sodium atom loses an electron from its valence shell and hence is _____ . (oxidised/reduced). [1]

**(b)** In the formation of magnesium oxide, the magnesium atom loses two electrons from its valence shell and hence is a _____. (oxidising agent/reducing agent). [1]

**(c)** In the formation of calcium oxide, the oxygen atom gains two electrons in its valence shell and hence is _____ . (oxidised/reduced) [1]

**(d)** In the formation of sodium sulphide, the sulphur atom gains two electrons in its valence shell and hence is a _____ . (oxidising agent/reducing agent) [1]

**(e)** Higher difference in the value of _____ between the reacting atoms, leads to the formation of ionic bond. (electronegativity/electopositivity)

**(f)** When the participating atoms in a chemical reaction are two _____ a covalent bond is formed. (metals/non-metals) [1]

**(g)** The _____ compounds in fused state or aqueous solution are good conductors of electricity. (ionic/covalent) [1]

**(h)** If participating atoms in a chemical reaction are a metal and a non-metal, the compound so formed has _____boiling point. (higher/lower) [1]

**(i)** When an atom or an ion loses an electron, it is said to be _____ . (oxidised/reduced). [1]

**(j)** A covalent compound in which a shared pair of electrons are _____ distributed between the atoms is called polar covalent compound. (equally/unequally) [1]

**Ans.** **(a)** oxidised **(b)** reducing agent

**(c)** reduced **(d)** oxidising agent

**(e)** electronegativity **(f)** non-metals

**(g)** ionic **(h)** higher

**(i)** oxidised **(j)** unequally

**3.** Draw the geometric representation of the following

**(i)** Period 2, group IV A element.

**(ii)** Period 2, group V A element.

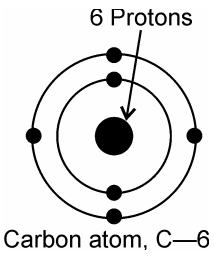
**(iii)**Period 2, group VI A element.

**(iv)**Period 3, group II A element.

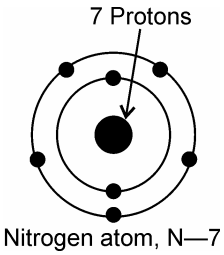
**(v)** Period 3, group VII A element.

**(vi)**Period 4, group I A element.

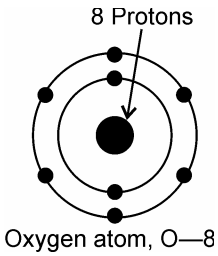
**Ans. (i)** Period 2, group IVA element is carbon. Its atomic number is 6. It has 2 electron in K-shell and its L-shell has 4 electrons.



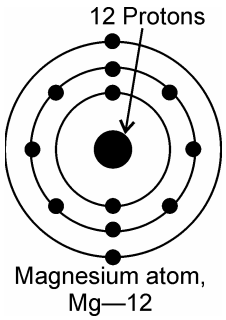

**(ii)** Period 2, group VA element is nitrogen. Its atomic number is 7. It has 2 electrons in K-shell and 5 electrons in L-shell.



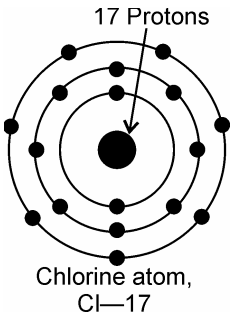

**(iii)** Period 2 group VIA element is oxygen. Its atomic number is 8. It has 2 electrons in K-shell and 6 electrons in L-shell.



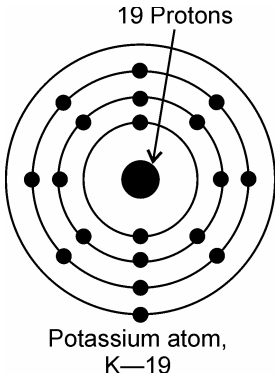

**(iv)** Period 3, group IIA element is magnesium. Its atomic number is 12. It has 2 electrons in K-shell, 8 electrons in L-shell and 2 electrons in M-shell.




**(v)** Period 3, group VIIA element is chlorine. Its atomic number is 17. It has 2 electrons in K-shell, 8 electrons in L-shell and 7 electrons in M-shell.



**(vi)** Period 4, group IA element is potassium. Its atomic number is 19. It has 2 electrons in K-shell, 8 electrons in L-shell, 8 electrons in M-shell and 1 electron in N-shell.




**4.** State why are noble gases unreactive while atoms of elements other than noble gas are chemically reactive. [3]

**Ans.** It has been established that if any element has two electrons in all, and these electrons are in the valance shell (duplet structure) or eight electrons in its valance shell, then the element is in the minimum state of energy. Such an element cannot donate/accept/share electrons with other elements and hence does not form a chemical bond.

As noble gases have duplet or octet structure, therefore, they are chemically inactive. However, all other elements do not have structure like that of noble gases. They can donate/accept/share electrons from their valance shell and hence are chemically active.

**5.** What is the charge on a chloride ion? How does this charge come about? [2]

**Ans.** **(i)** The chloride ion has unit negative charge.

**(ii)** When the chlorine atom (2, 8, 7) accepts one electron so as to have a stable argon like structure, there is one electron in excess, as compared to the number of protons in the nucleus. This in turn makes chloride ion negatively charged.

**6.** Sodium oxide [$Na_2O$] contains ionic bonding. Write down the formulae of ions in sodium oxide. What changes in electron arrangement occur when these ions are formed from sodium and oxygen atoms? What type of force hold these ions together? [4]

**Ans.** The sodium oxide contains the following ions :

**(1)** Two sodium ions, each having a unit positive change, i.e., $2Na^{+}$.

**(2)** One oxide ion, having 2-units negative charge, i.e., $O^{2-}$. The sodium atom has electronic configuration (2, 8, 1). It loses one electron from its valence shell to have a stable electronic configuration (2, 8) like that of the neon gas.

$$Na - e^{-} \longrightarrow Na^{+}$$

(2, 8, 1) Sodium atom — (2, 8) [Neon-like configuration] Sodium ion

The oxygen atom has electronic configuration (2, 6). It accepts two electrons in its valence shell to have a stable electronic configuration (2, 8) like that of the neon gas.

$$O + 2e^{-} \longrightarrow O^{2-}$$

(2, 6) Oxygen atom — (2, 8) [Neon-like configuration] Oxide ion

The electrostatic forces between the sodium and oxide ions hold them together.

**7.** Use the list given below to answer the following questions :

List : diamond, sodium chloride, silicon dioxide, methane.

**(a)** Which substance in the list is an example of a non-polar molecule?

**(b)** Which substance in the list is an example of an element with giant structure of atoms?

**(c)** Which substance in the list is an example of giant structure of ions?

**(d)** Which substance in the list is an example of a compound with giant structure of molecules? [4]

**Ans.** **(a)** Methane **(b)** Diamond

**(c)** Sodium chloride **(d)** Silicon dioxide

**8.** Why are metals good conductor of electricity? [2]

**Ans.** All metals have one to three electrons in their valence shell, which are very loosely held by the nucleus. When an electric p.d. is applied, these almost free electrons start drifting in one particular direction, thereby making the metals good conductor of electricity.

**9.** **(i)** Draw diagrams to show the arrangement of electrons in sodium $\left[{}^{23}_{11}Na\right]$ atom and fluorine atom $\left[{}^{19}_{9}F\right]$. [1]

**(ii)** Draw a diagram to show valence electrons in a fluorine molecule [$F_2$]. [2]

**(iii)** What type of bonding is present in the fluorine molecule? [1]

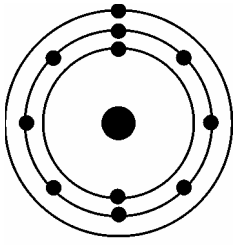
**(iv)** When sodium and fluorine combine, electron transfer takes place and ions are formed. What kind of electron transfer takes place in each atom? [2]

**(v)** Write down one similarity and one difference between sodium ion and fluoride ion. [2]

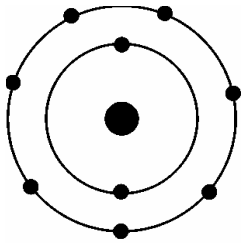
**(vi)** What is a giant structure? [1]

**(vii)** Suggest two physical properties of sodium fluoride. [2]

**Ans.** **(i)**

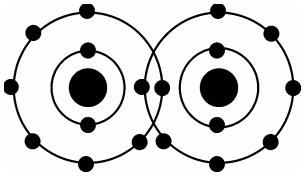


Sodium atom



Fluorine atom

**(ii)**



**Fluorine molecule [$F_2$]**

**(iii)** Covalent bonding is present in the fluorine molecule.

**(iv)** Sodium atom loses an electron to form sodium ion. Fluorine atom gains an electron to form fluoride ion.

**(v)** **Similarity :** Both have electronic configuration of (2, 8), i.e., like neon gas.

**Difference :** Both have different number of protons and neutrons.

**(vi)** When large number of particles are joined together to form a single network, it is called giant structure. In sodium fluoride it is a giant structure of $Na^+$ and $F^-$ ions.

**(vii)** Sodium fluoride is likely to have high melting point. It is likely to conduct electricity in aqueous solution or fused state.

**10.** What is meant by the term "electrovalency"? State why sodium (at. no. 11] has electrovalency +1 and chlorine (at. no. 17) has electrovalency of –1. [4]

**Ans.** Electrovalency : The number of electrons donated (lost) or accepted (gained) by an atom of an element, from its valence shell, such that the ion formed (residual particle) has an electronic configuration of nearest noble gas is called electrovalency of the element.

If the electrons are donated, then the electrovalency is said to be positive. If the electrons are accepted, then the electrovalency is said to be negative.

Sodium atom [at. no.—11] has 11 protons in its nucleus and its electronic configuration is (2, 8, 1). The sodium atom donates one electron from its valence shell to have the electronic configuration of nearest noble gas neon. However, in doing so, it has 11 protons in its nucleus and 10 electrons. Thus, the residual atom (sodium ion) has a unit positive charge or has electrovalency + 1.

Chlorine atom (at. no. 17) has 17 protons in its nucleus and its electronic configuration is [2, 8, 7]. The chlorine atom accepts one electron in its valence shell to have electronic configuration of nearest noble gas argon. However, in doing so, it has 17 protons in its nucleus and 18 electrons. Thus, the residual atom (chloride ion) has a unit negative charge or has electrovalency –1.

**11.** State three differences between an atom X and its ion $X^{1+}$ [4]

**Ans.** **1.** In atom X, the number of protons in its nucleus are equal to number of electrons revolving around its nucleus.
In ion $X^{1+}$, the protons in the nucleus are 1 more than the electrons revolving around its nucleus.

**2.** In atom X, its valence shell does not have electronic configuration like noble gases.

In ion $X^{1+}$, its valence shell has electronic configuration like noble gases.

**3.** Atom X is chemically active and hence can enter into a chemical reaction. It can exist independently. Ion $X^{1+}$ is chemically inactive and hence cannot enter into a chemical reaction. It cannot exist independently.

**12.** **(a)** Why do elements form ions in certain chemical reactions? [2]

**(b)** What kind of elements form positively charged ions? Support your answer by two examples. [2]

**(c)** What kind of elements form negatively charged ions? Support your answer by two examples. [2]

**Ans.** **(a)** With the exception of noble gases which have eight electrons in their valence shells (He has 2 electrons) and are in the minimum state of energy, all other elements have one to seven electrons in their valence shells. Thus, to attain a state in which they have minimum energy, they either lose or gain electrons, so that their valence shell has eight electrons. However, in

doing so their positive and negative charges get unbalanced and hence they form charged ions.

**(b)** Metals form positively charged ions.

$$Na - e^- \longrightarrow Na^{1+}$$

$$Mg - 2e^- \longrightarrow Mg^{2+}$$

**(c)** Non-metals form negatively charged ions.

$$Cl + e^- \longrightarrow Cl^{1-}$$

$$S + 2e^- \longrightarrow S^{2-}$$

**13.** Define the terms :

**(a)** Electrovalent or ionic bond.

**(b)** Molecular or covalent compound.

**(c)** Coordinate covalent bond.

**Ans.** **(a)** **Electrovalent bond** :The electrostatic bond formed between two different atoms (usually a metal or a non-metal), such that metallic atom donates all its electrons from the valence shell and the non-metallic atom/atoms accept these donated electrons, with the formation of cations and anions which mutually bind each other is called electrovalent bond or ionic bond.

**(b)** **Molecular bond or Covalent bond** : A chemical bond formed between two non-metallic elements by sharing electron pair/pairs from the valence shells of reacting atoms, such that both the atoms acquire the electronic configuration of nearest noble gas is called molecular bond or covalent bond.

**(c)** **Coordinate covalent bond** : The bond formed between an ion and an atom of polar covalent compound, having a lone pair/pairs of electrons, such that the ion accepts the lone pair is called coordinate covalent bond.

**14.** **(a)** What do you understand by the term ionic compound? [2]

**(b)** Name two ionic compounds, stating clearly the charge on each of the participating ion. [2]

**(c)** Why do ionic compounds have high melting points and high boiling points? [1]

**Ans.** **(a)** A compound formed by the donation of electrons from the valence shell of a metal, such that, these electrons are accepted in the valence shell of a non-metal is called ionic compound.

**(b)** (1) Sodium chloride $Na^{1+}Cl^{1-}$ (2) Zinc oxide $Zn^{2+}O^{2-}$

**(c)** In an ionic compound the ions are held very strongly due to strong electrostatic forces. Thus, they require a large amount of heat energy, so as to snap the electrostatic bond. Because of this requirement of large amount of energy, ionic compounds have high melting points and high boiling points.

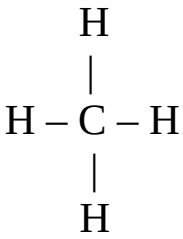
**15.** **(a)** What do you understand by the term covalent compound? [2]

**(b)** Name two covalent compounds, showing clearly the bond/bonds between two participating atoms. [2]

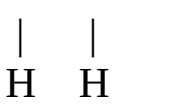
**(c)** Why do covalent compounds have low melting point and low boiling point? [1]

**Ans.** **(a)** A compound formed by mutual sharing of a pair or pairs of electrons by the atoms of two same or different elements, such that each of them has a stable octet structure is called a covalent compound.

**(b)** (1) Methane $[CH_4]$



(2) Ethylene [$C_2H_4$]



**(c)** The molecules of a covalent compound are held by weak van der Waals' forces. Thus, a very small amount of energy is required to break the bonding between two molecules. It is because of the requirement of low energy to break molecular bonding, that they have low melting points and low boiling points.

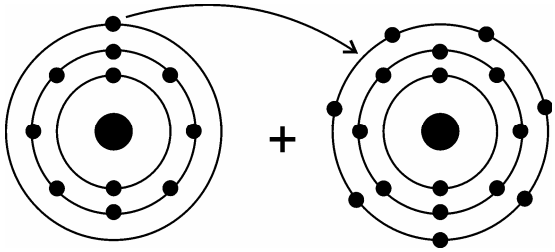
**16.** Explain with the help of (i) atomic or orbital structural diagram (ii) electron dot diagram, and (iii) ionic equation for the formation of following :

(a) Sodium chloride, (b) Calcium oxide,

(c) Magnesium chloride [3 × 3]

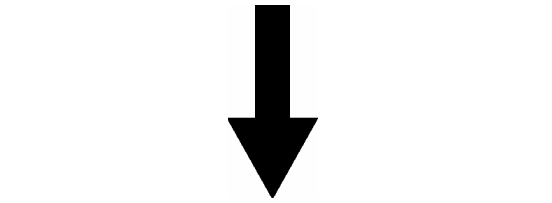
**Ans. (a) Formation of sodium chloride**

**(i) Structural diagram**



Sodium atom
Sodium atom (Na)
2, 8, 1

Chlorine atom
Chlorine atom (Cl)
2, 8, 7



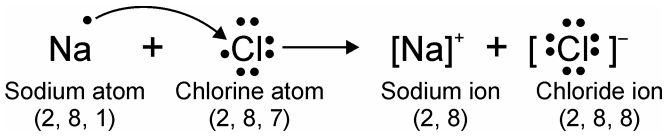

$Na^+$ $Cl^-$

Sodium chloride compound

Sodium ion ($Na^+$)
2, 8

Chloride ion ($Cl^-$)
2, 8, 8

(ii) Electron dot diagram




(iii) Ionic Equation :

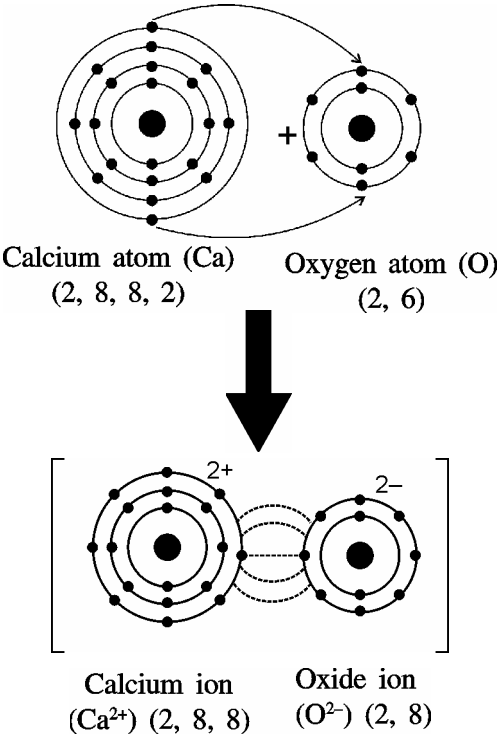
$$Na - e^- \rightarrow Na1^+$$

$$Cl + e^- \rightarrow Cl^{1-}$$

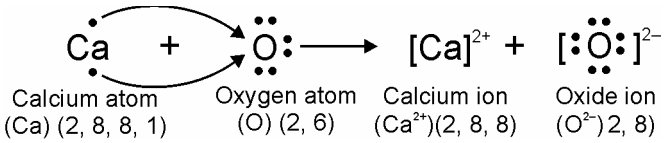
$$Na + Cl \rightarrow Na^{1+}Cl^{1-}$$

## (b) Formation of Calcium oxide

### (i) Structural diagram




### (ii) Electron dot diagram

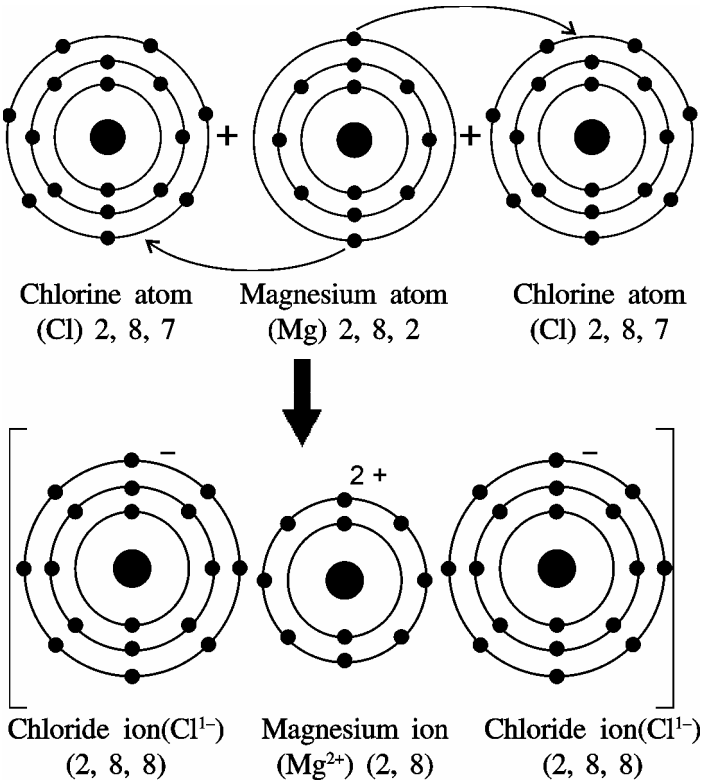



### (iii) Ionic Equation :

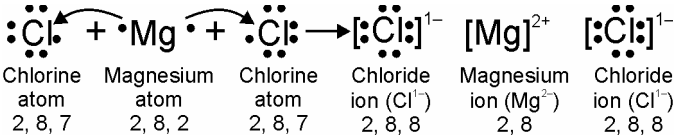
$$Ca - 2e^- \rightarrow Ca^{2+}$$
$$O + 2e^- \rightarrow O^{2-}$$
$$Ca + O \rightarrow Ca^{2+}O^{2-}$$

(c) Formation of Magnesium Chloride

**(i) Structural diagram**




**(ii) Electron dot diagram**




**(iii) Ionic Equation :**

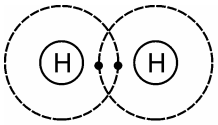
$$Mg - 2e^- \rightarrow Mg^{2+}$$
$$2Cl + 2e^- \rightarrow 2Cl^{1-}$$
$$Mg + 2Cl \rightarrow Mg^{2+}\ Cl_2^{1-}$$

**17.** Explain with the help of (i) orbital or structural diagram, (ii) electron dot diagram, the formation of following molecules, stating the valency of each participating element.

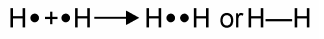
(a) Hydrogen (b) chlorine (c) oxygen (d) nitrogen, (e) water, (f) fluorine (g) methane (h) carbon
(i) Ammonia (j) carbon dioxide.

[Atomic numbers : H = 1, Cl = 17, O = 8, N = 7, F = 9, C = 6] [3 × 10]

**Ans.(a) Hydrogen ($H_2$)**



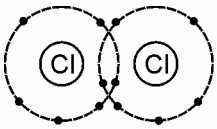
Structural diagram of Hydrogen



Electron dot diagram of hydrogen

Valency of each hydrogen atom in $H_2$ is 1.

**(b) Chlorine ($Cl_2$)**

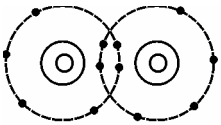


Structural diagram of chlorine

Electron dot diagram of chlorine

Valency of each chlorine atom in $Cl_2$ is 1.

**(c) Oxygen ($O_2$)**

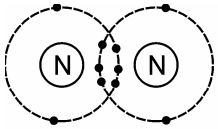


Structural diagram of oxygen

Electron dot diagram of oxygen

Valency of each oxygen atom in $O_2$ is 2.

### (d) Nitrogen ($N_2$)

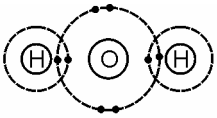


Structural diagram of nitrogen

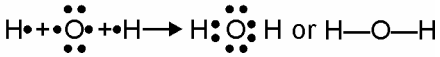
Electron dot diagram of nitrogen

Valency of each nitrogen atom in $N_2$ is 3.

### (e) Water ($H_2O$)



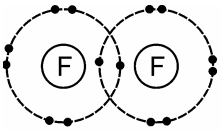
Structural diagram of $H_2O$



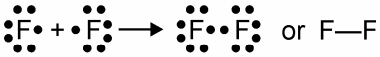
Electron dot diagram of $H_2O$

Valency of each hydrogen is 1 and oxygen is 2 in the molecule of water.

### (f) Fluorine ($F_2$)



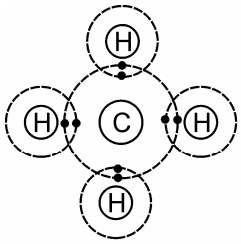
Structural diagram of fluorine



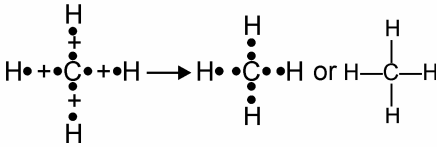
Electron dot diagram of fluorine

Valency of each fluorine atom in $F_2$ is 1.

### (g) Methane ($CH_4$)



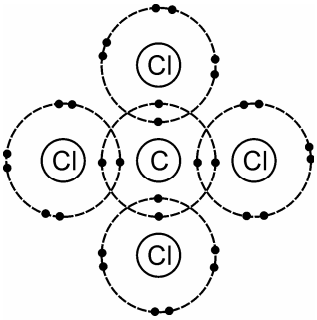
Structural diagram of methane



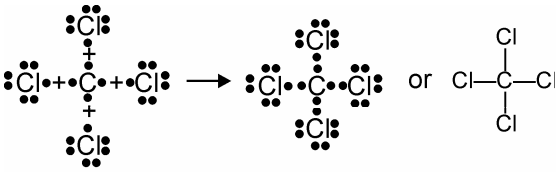
Electron dot diagram of methane

Valency of carbon is 1 and each hydrogen is also 1 in molecule of methane.

## (h) Carbon tetrachloride ($CCl_4$)



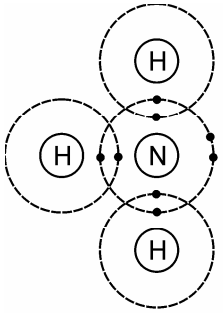

Structural diagram of $CCl_4$



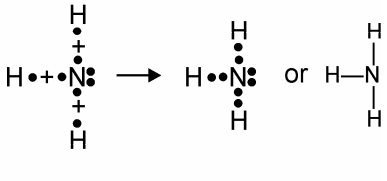

Electron dot diagram of $CCl_4$

Valency of carbon is 4 and each chlorine is 1 in the molecule of carbon tetrachloride.

## (i) Ammonia ($NH_3$)



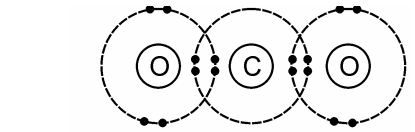

Structural diagram of $NH_3$




Electron dot diagram of $NH_3$

Valency of nitrogen atom is 3 and each of hydrogen atom is 1 in the molecule of ammonia.

**(j) Carbon dioxide ($CO_2$)**




Structural diagram of carbon dioxide


Electron dot diagram of carbon dioxide

Valency of each of the oxygen atom is 2 and carbon atom is 4 in one molecule of carbon dioxide.

**18.** Fill in the blank spaces with appropriate words.

**(i)** Sodium chloride is an ionic compound formed as a result of transfer of _____valence electron from metallic sodium to non-metallic chlorine atom.

**(ii)** Calcium oxide is an ionic compound formed as a result of transfer of _____ valence electrons from metallic calcium to non-metallic oxygen atom.

**(iii)** Magnesium chloride is an ionic compound formed as a result of transfer of _____ valence electrons from metallic magnesium to _____ atoms of non-metallic chlorine.

**Ans. (i)** one, **(ii)** two, **(iii)** two, two

**19.** Covalent compounds are formed by sharing electron pairs between non-metallic atoms. Non-metallic atoms having (i) , (ii) , (iii) . valence electrons share one, two or three pairs of electrons, respectively. [2]

**Ans. (i)** 7, **(ii)** 6, **(iii)** 5

**20.** Why the molecules of hydrogen and chlorine have single covalent bond between their atoms? [2]

**Ans.** Hydrogen has only one electron in its valence shell, whereas chlorine has 7 electrons in its valence shell. Thus, in order to have a stable electronic configuration of nearest noble gas, they share one electron pair, such that hydrogen has duplet configuration like helium and chlorine has octet configuration like argon.

**21.** Why the molecules of oxygen have a double covalent bond in between there atoms? [2]

**Ans.** Oxygen atom has six valence electrons. Thus, in order to have a stable electronic configuration of nearest noble gas neon, each atom of oxygen shares two electron pairs. Thus, a double covalent bond is formed between two atoms of oxygen.

**22.** Why the molecules of nitrogen have a triple covalent bond between their atoms. [2]

**Ans.** Nitrogen atom has five valence electrons. Thus, in order to have a stable electronic configuration of nearest noble gas neon, two atoms of nitrogen share three pairs of electrons between themselves. Thus, a triple covalent bond is formed between two atoms of nitrogen.

**23.** Why the molecule of methane has four single covalent bonds? [2]

**Ans.** Carbon atom has four electrons in its valence shell, whereas hydrogen atom has one electron in its valency. Thus, in order to have a stable electronic configuration of nearest noble gas neon, each carbon atom shares four electron pairs with four atoms of hydrogen. This results in the formation of 4 covalent bonds between the carbon atom and four atoms of hydrogen.

**24.** **(a)** Why is methane molecule regarded as a non-polar covalent compound? [2]

**(b)** Why is hydrogen chloride molecule called a polar covalent compound? [2]

**Ans.** **(a)** It has been found that a methane molecule has a three-dimensional tetrahedral structure. The four carbon hydrogen bonds are directed towards the four corners of tetrahedron. In such a configuration, none of the participating atoms is more electrically charged as compared to other atoms. Hence, methane molecule is a non-polar covalent compound.

**(b)** In case of hydrogen chloride, the strong nuclear charge of chlorine atom attracts the electron of hydrogen atom far away from its nucleus. Thus, the hydrogen atom develops a slightly positive charge ($\delta^+$) and the chlorine atom develops a slightly negative charge ($\delta^+$). Such a covalent bond between the atoms of hydrogen and chlorine is called a polar covalent bond.

**25.** An element P has electronic configuration (2, 8, 18, 8, 1). Without identifying P :

**(i)** Predict the sign and charge on simple ion of P.

**(ii)** State whether you would expect the element P to be a metal or a non-metal.

**(iii)** Write the probable formula and appearance of chloride of P.

**(iv)** Write the probable formula and solubility of hydroxide of P. [4]

**Ans.** **(i)** $P^{1+}$. It has a unit positive charge.

**(ii)** Element P is a metal.

**(iii)** The formula of chloride of P is $P^+Cl^-$. It is likely to be white crystalline solid.

**(iv)** The formula of hydroxide of P is $P^+OH^-$. It is likely to be very soluble in water.

**26.** The table below gives some information regarding elements D, E, F, G and H.

| Element | Atomic Weight | Atomic number | Arrangement of electrons |
|---|---|---|---|
| **D** | 9 | 4 | 2, 2 |
| **E** | 19 | 9 | 2, 7 |
| **F** | 23 | 11 | 2, 8, 1 |
| **G** | 31 | 15 | 2, 8, 5 |
| **H** | 40 | 18 | 2, 8, 8 |

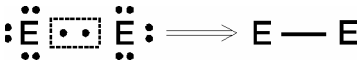
**(i)** Will the compound formed by E and F have ionic or molecular structure?

**(ii)** Give the structure (electron dot diagram) of molecule $E_2$ between E and E.

**(iii)** Which two elements can form ions with electronic configuration of noble gas neon (atomic number 10)?

**(iv)** Which elements can be described unreactive? [4]

**Ans. (i)** The compound of E and F will have ionic structure.

**(ii)** 


**(iii)** Elements E and F can form ions with electronic configuration of neon.

**(iv)** Element H is unreactive.

**27.** Taking sodium chloride as an example of ionic compound and carbon tetrachloride as an example of molecular compound, give two differences between ionic compounds and molecular compounds. [2]

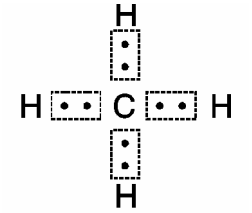
**Ans. (1)** An ionic compound is a crystalline solid having high m.p., as in case of sodium chloride, whereas molecular compound is a volatile liquid, having low boiling point, as in case of carbon tetrachloride.

**(2)** An ionic compound is a good conductor of electricity in its aqueous solution, as in case of sodium chloride, whereas molecular compound is a bad conductor of electricity, as in case of carbon tetrachloride.

**28.** The hydrogen atom has only one electron and carbon atom has four valence electrons. Write the electronic configuration of :

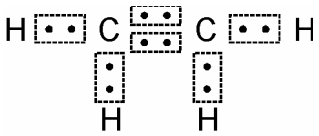
(i) Methane [$CH_4$] (ii) Ethylene [$C_2H_4$] [4]

**Ans. (i)**




Electronic configuration of methane

**(ii)**




Electronic configuration of ethylene

**29.** Sodium atom is highly reactive, but sodium ion is not. Explain.[2]

**Ans.** Sodium atom has electronic configuration (2, 8, 1). Because of the presence of one electron in its valence shell, it can easily donate it to any other non-metallic element, and hence is most reactive. Sodium ion has electronic configuration (2, 8, …). As its valence shell is of eight electrons like neon gas, therefore, it is non-reactive in nature.

**30.** Why is hydrogen ion called proton? Explain as clearly as possible. [2]

**Ans.** An atom of hydrogen has one proton in its nucleus and one electron in its valence shell. Thus, when hydrogen atom donates its valence electron, the residual ion consists of a single proton. It is on account of this fact that the hydrogen ion is called proton.

**31.** The electronic configuration of elements A, B and C is : A = (2, 8, 1); B = (2, 8, 6) and C = (2, 8, 18, 7).

**(a)** Write down the formula of a molecule of B, its electron dot diagram and the type of bonding.

**(b)** Write down the formula of a compound formed between A and C, and type of bonding.

**(c)** Classify elements A, B and C as metals and non-metals.

**(d)** Which element is likely to be a good conductor and why? [4]

**Ans. (a)** Formula of B is $B_2$.

Dot diagram for the molecule of B is shown alongside.


$B_2$ has a covalent bonding.

**(b)** The formula of compound A and C is $A^+C^-$.

This compound has ionic bonding.

**(c)** Element A is a metal.

Elements B and C are non-metals.

**(d)** The element A is likely to be a good conductor. It is because its single valence electron is held very loosely in the valence shell.

**32.** A, B, C and D are elements whose atomic numbers are 16, 19, 18 and 13, respectively.

Write the electronic configuration of each element. Also state whether these elements are metals, non-metals or noble gases.

**Ans.**

| Elements | At. No. | Electronic configuration | Nature |
|---|---|---|---|
| A | 16 | 2, 8, 6 | Non-metal |
| B | 19 | 2, 8, 8, 1 | Metal |
| C | 18 | 2, 8, 8 | Noble gas |
| D | 13 | 2, 8, 3 | Metal |

**33.** How do metals differ from non-metals in :

**(1)** ion formation

**(2)** electronic configuration

**(3)** chemical nature of their oxides? [3]

**Ans. (1)** Metals form positively charged ions, whereas non-metals form negatively charged ions.

**(2)** Metals have 1 to 3 electrons in their valence shells, whereas non-metals have 4 to 7 electrons in their valence shells.

**(3)** The oxides of metals are basic in nature, whereas oxides of non-metals are acidic or neutral in nature.

**34.** An atom of fluorine may be written as $_9F^{19}$. Using dot diagram to show electrons in the outermost shell, show how a molecule of fluorine ($F_2$) is formed? What is the name given to this kind of bonding? [2]

**Ans.** Dot diagram of fluorine


The kind of bonding is covalent.

**35.** The number of protons and orbital electrons in the particles from A to C are given below.

| **Particles** | **A** | **B** | **C** |
|---|---|---|---|
| Protons | 3 | 9 | 17 |
| Electrons | 2 | 10 | 17 |

**(i)** From above table choose a letter which represents (i) a cation (ii) an anion?

**(ii)** Write the formula of the compound you would expect to be formed between C and hydrogen?

**(iii)** Write the formula of compound containing only particles of A and B? Give two physical properties you would expect this compound to have and what type of bonding is there. [4]

**Ans. (i)** A represents cation. B represents anion.

**(ii)** The formula of compound is CH.

**(iii)** The formula of compound containing only particles of A and B is $A^{+}B^{-}$.

The above compound has the following physical properties :

(1) It is soluble in water.

(2) It has high m.p. and high b.p.

The ionic bonding exists between A and B.

**36. (a)** Name one compound which is covalent, but on dissolving in water conducts electricity.

**(b)** Which one property of above compound, agrees with its being a covalent compound? [2]

**Ans. (a)** Hydrogen chloride.

**(b)** Hydrogen chloride is a gas. In dry state, it is a bad conductor of electricity. Hence, it is a covalent compound.

**37.** What do you understand by the term ionic bond? State at least three conditions for its formation. [4]

**Ans.** An electrostatic bond formed between a metal and a non-metal, such that the metallic element donates electron/electrons and the non-metallic element accepts electron/electrons, resulting in the formation of cations and anions is called an ionic bond.

**Conditions for the formation of ionic bond**

1. **Electronegativity :** More the difference between the values of electronegativity of the combining atoms, more easily the electron transference takes place resulting in the formation of ionic bond.
2. **Ionisation potential :** Lower the value of ionisation potential of a metallic element, more easily it will form cations and hence result in the formation of ionic bond.
3. **Electron affinity :** Higher the value of electron affinity of a non-metal, greater the ease with which it accepts electrons in its valence shell to form anions, resulting in the formation of ionic bond.

**38.** State four periodic properties which are responsible for the formation of ionic compounds. [2]

Ans. **(i)** Large difference between the values of electronegativity of the combining atoms.

**(ii)** Large difference between the values of ionisation potential of the combining atoms.

**(iii)** Large difference between the values of atomic radii of the combining atoms.

**(iv)** Large difference between the values of electron affinity of the combining atoms.

**39.** State four periodic properties which are responsible for the formation of covalent compounds. [2]

**Ans.** **(i)** Small difference between the values of electronegativity of the combining atoms.

**(ii)** Small difference between the values of ionisation potential of the combining atoms.

**(iii)** Small difference between the values of electron affinity of the combining atoms.

**(iv)** The combining atoms should be non-metals.

**40.** Why are ionic compounds crystalline solids? [2]

**Ans.** Ionic compounds are aggregates of positively charged ions (cations) and negatively charged ions (anions), held together by very strong electrostatic forces. As the ions are not free to move in any direction, therefore, on the whole an ionic compound is a hard crystalline solid.

**41.** Why are the ionic compounds soluble in water? [2]

**Ans.** Water is a polar covalent compound in which hydrogen atoms are slightly positively charged and oxygen atoms slightly negatively charged. When a number of water molecules align with the cations (positively charged ion) of an ionic compound such that oxygen ions are facing it, then they try to pull the cations out of the ionic bond. Conversely, when the number of hydrogen ions of water surround an anion of ionic compound, they try to pull the anion out of the ionic bond. Because of these electrostatic pull exerted by water molecules, the ionic bond breaks and hence the ionic compound dissolves in water.

**42.** Why are ionic compounds good conductor of electricity in aqueous solution or in the fused state?

**Ans.** In an aqueous solution or in the fused state, ionic bond between the oppositely charged ions breaks. Thus, the ions are free to move about in all directions.

When electric potential is applied to such a solution, the cations migrate to the cathode and the anions migrate to anode. Due to the migration of ions to the oppositely charged electrodes the solution of ionic compound conducts electricity.

**43.** Define (i) non-polar covalent compound (ii) polar covalent compound. Support your answer by giving at least one example. [2]

**Ans. (i)** A covalent compound in which shared pairs of electrons are equally distributed between the combining atoms is called a non-polar covalent compound.

For example molecule of methane has non-polar covalent bonds between the carbon and hydrogen atoms.

**(ii)** A covalent compound in which shared pairs of electrons are not equally distributed is called polar covalent compound.

HCl gas and $H_2S$ are the examples of polar covalent compounds.

**44.** Give three differences between polar covalent compound HCl and non-polar covalent compound methane ($CH_4$). [3]

**Ans. Polar covalent compound (HCl)**

**1.** The shared pair of electrons is unequally distributed between the hydrogen and chlorine atoms.

**2.** The HCl molecule is asymmetrical and is not electrically neutral.

3. The shared pair of electrons between the hydrogen and chlorine atom, stays more towards chlorine, thereby making it slightly negative and the hydrogen atom slightly positive.

**Non-polar covalent compound ($CH_4$)**

1. The shared pair of electrons between carbon atom and four hydrogen atoms are equally distributed.
2. The $CH_4$ molecule is symmetrical and is electrically neutral.
3. The shared pair of electrons between the hydrogen atom and the carbon atom mutually attracts each other with the same force. This makes methane atom neutral in character.

**45.** Why are covalent compounds generally gases, or liquids or soft solids? [2]

**Ans.** It is because, the molecules of covalent compounds are acted upon by weak intermolecular forces, or van der Waals' forces, which are insufficient to hold the molecules together.

**46.** Why are non-polar covalent compounds insoluble in water? [2]

**Ans.** Non-polar covalent compounds do not have free ions. Thus, water molecules cannot tear apart these molecules and hence they are insoluble in water.

**47.** Why are polar covalent compounds soluble in water? [2]

**Ans.** Polar covalent compounds have weakly held negative and positive atoms in their molecules. Thus, the water molecules can pull them apart by aligning with them in suitable form. As, the ions of the polar covalent compounds are pulled apart, they dissolve in water.

**48.** Why are non-polar covalent compounds bad conductor of electricity? [2]

**Ans.** Non-polar covalent compounds do not have free ions. Thus they do not dissolve in polar covalent water. As no free ions are produced, therefore non-polar covalent compounds are bad conductor of electricity.

**49.** Why are polar covalent compounds good conductor of electricity? [2]

**Ans.** Polar covalent compounds easily ionise in water to form cations and ions. Thus, when electric potential is applied, these ions migrate to oppositely charged poles and discharge. This results in the conduction of electric current.

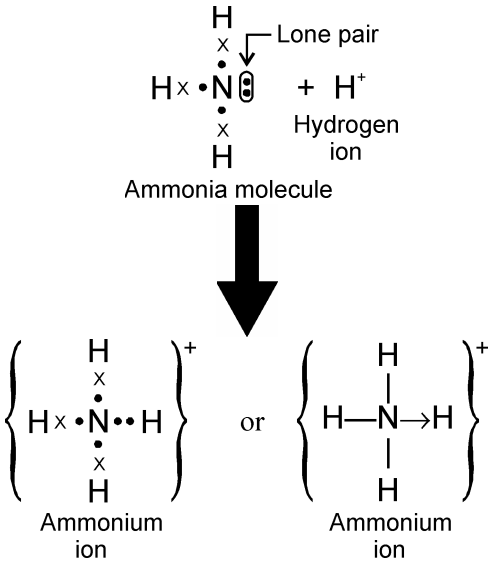
**50.** What is lone pair effect? In what kind of compounds does this effect occur? [2]

**Ans.** When the unshared pair of electrons around an atom in the middle of a molecule is completely shared by another atom or an ion, it is called lone pair effect.

Lone pair effect is shown by polar covalent compounds such as HCl and $NH_3$.

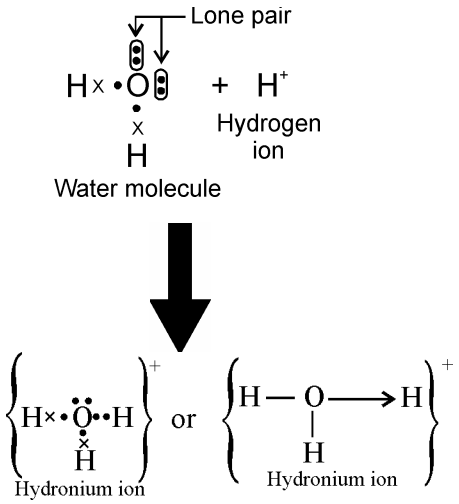
**51.** By drawing dot diagram, show the lone pair effect leading to the formation of ammonium ion from ammonia gas and hydrogen ion. [2]

**Ans.**



**52.** By drawing the dot diagram, show the lone pair effect leading to the formation of hydronium ion from water and hydrogen ion. [2]

**Ans.**




**53.** Sodium (at. no. 11) and chlorine (at. no. 17), react to form the compound sodium chloride. Taking the example of above reaction, explain the following on the basis of electron concept.

(a) Oxidation (b) Reduction

(c) Oxidising agent (c) Reducing agent [4]

**Ans.** $\underset{(2,8,1)}{Na} - e^- \longrightarrow \underset{(2,8)}{Na^+}$ [Neon-like electronic configuration]

$\underset{(2,8,7)}{Cl^-} + e^- \longrightarrow \underset{(2,8,8)}{Cl^-}$ [Argon-like electronic configuration]

**(a)** When an atom or an ion loses an electron, its oxidation takes place. In the above example, as sodium loses an electron, its oxidation takes place.

**(b)** When an atom or an ion gains an electron, its reduction takes place. In the above example as chlorine atom gains an electron, its reduction takes place.

**(c)** The atom/ion which gains electron/electrons is said to be oxidising agent. In the above example, as the chlorine gains an electron, therefore, it is an oxidising agent.

**(d)** The atom/ion which loses electron/electrons is said to be a reducing agent. In the above example, as the sodium atom loses an electron, therefore, it is a reducing agent.

**54.** $Fe + S \longrightarrow Fe^{2+}S^{2-}$

Which substance in the above reaction is
**(a)** oxidising agent (**b)** reducing agent and why? [2]

**Ans. (a)** Sulphur is oxidising agent as it accepts 2 electrons to form $S^{2-}$ ion.

**(b)** Iron is reducing agent as it loses 2 electrons to form $Fe^{2+}$ ion.

**55.** $2Fe + 3Cl_2 \longrightarrow 2Fe_3 + CI_3^{1-}$

In the above reaction, which substance is (i) oxidised (ii) reduced, and why? [2]

**Ans. (i)** Iron is oxidised as the loss of electrons means oxidation.

**(ii)** Sulphur is reduced as the gain of electrons means reduction.

**56.** State which of the following are (i) oxidation reaction, (ii) reduction reaction and why? [2]

**(a)** $Cu \longrightarrow Cu^{2+} + 2e^-$

**(b)** $X + 2e^- \longrightarrow X^{2-}$

**(c)** $Sn^{4+} + 2e^- \longrightarrow Sn^{2+}$

**(d)** $Y - 1e^- \longrightarrow Y^{1+}$

**(e)** $2Cl^- \longrightarrow Cl_2 + 2e^-$

**(f)** $Zn^{3+} + 1e^- \longrightarrow Z^{2+}$

**(g)** $Fe^{2+} \longrightarrow Fe^{3+} + 1e^-$

**(h)** $Al - 3e^- \longrightarrow Al^{3+}$

**Ans. (i) Oxidation reactions :**

(a), (d), (e), (g) and (h) are oxidation reactions.

It is because in each of the reactions the atom/ion loses (donates) an electron and the loss of electron means oxidation reaction.

**(ii) Reduction reactions :**

(b), (c) and (f) are reduction reactions.

It is because in each of the reactions the atom/ion gains (accepts) an electron and the gain of electron means reduction reaction.