Chapter 4 Chemical Bonding

Section A — Multiple Choice Questions (M.C.Qs)

Tick mark (✓) the correct answer:

01. *An example of the ionic compound is:*
(a) H_2 (b) CH_4 (c) N_2 (d) NaCl

02. *Interaction between highly electron deficient hydrogen and highly electronegative atom is called*
(a) covalent bond (b) ionic bond (c) hydrogen bond (d) metallic bond

03. *Two fluorine atoms share one electron each in their outermost shell to achieve the electronic configuration of:*
(a) Xe (b) Ar (c) Kr (d) Ne

04. *Number of electrons lost by atoms of group IIIA equals:*
(a) 1 (b) 2 (c) 3 (d) 4

05. *Atom which loses two electrons from its outer shell to form ion is called:*
(a) oxygen (b) potassium (c) magnesium (d) carbon

06. *In NaCl crystal lattice each Na^+ ion is surrounded by:*
(a) 6 Cl^- ions (b) 6 Na^+ ions (c) 8 Cl^- ions (d) 12 Cl^- ions

07. *At room temperature most of ionic compounds are:*
(a) amorphous solids (b) crystalline solids (c) liquids (d) gases

08. *Tendency of atoms to acquire eight electrons in their valence shell is:*
(a) octet rule (b) duplet rule (c) triplet rule (d) none of above

09. *When one atom forms cation by losing an electron and the other forms anion by accepting that electron then bond form between them is:*
(a) covalent bond (b) ionic bond
(c) coordinate covalent bond (d) hydrogen bond

10. *Nobel gases are stable because they contain:*
(a) 4 electrons in valence shell (b) 6 electrons in valence shell
(c) 8 electrons in valence shell (d) 10 electrons in valence shell

11. *Bond which involves 3 shared electron pairs is a:*
(a) double covalent bond (b) single covalent bond
(c) triple covalent bond (d) None of above

12. *A non-metal atom form anion by:*
(a) loses of electrons (b) gain of electrons
(c) loses of protons (d) gain of protons

13. *When two identical atoms share electron pairs and exert force on each other then the bond form is:*
(a) non-polar covalent bond (b) polar covalent bond
(c) double covalent bond (d) coordinate covalent bond

14. *Synthetic resins are used on places where:*
(a) electric resistance is required (b) water resistance is required
(c) adhesion is required (d) friction is required

15. *Oxygen belongs to group VIA so the number of electrons in its valence shell is:*
(a) 3 (b) 4 (c) 5 (d) 6

16 *Electron pairs which are not shared by atoms are called:*
(a) electron pairs (b) lone pairs (c) bond pairs (d) shared pairs

17. *Strength of intermolecular forces from ionic to covalent bond is:*
(a) weaker (b) stronger (c) equal (d) None of above

18. *Ionic crystals have:*
(a) high melting points (b) moderate melting points
(c) low melting points (d) None of above

19. *Bond formed by mutual sharing of the electron is:*
(a) ionic bond (b) coordinate covalent bond
(c) covalent bond (d) metallic bond

20. *Which of the following diagram shows atoms are bonded with the same electronegativity?*
(a) A—B (b) A—B (c) A—B (d) A—B

21. *The attractive force which binds atoms together is called:*
(a) a chemical bond (b) chemical forces (c) Both 'a' & 'b' (d) None of them

22. *Helium, neon, argon, xenon and krypton present in the atmosphere consist of:*
(a) un-bounded atoms (b) bounded atoms (c) ionic bonds (d) covalent bonds

23. *Electronic configuration of noble gases is:*
(a) ns^2np^4 (b) ns^2np^5 (c) ns^2np^6 (d) nd^2np^8

24. *Which one is not a noble gas?*
(a) Helium (b) Argon (c) Radon (d) Oxygen

25. *Noble gases are sometimes called the:*
(a) slow gases (b) inactive gases (c) inert gases (d) idle gases

26. *The outermost shell of the noble gases is:*
(a) completely filled (b) half-filled (c) partially filled (d) None of these

27. *All noble gases contain 8 electrons in the valence shell except:*
(a) neon (b) krypton (c) xenon (d) helium

28. *Because of these electronic configurations of noble gases are:*
(a) stable and active (b) stable and not active
(c) unstable and active (d) unstable and not active

29. *Atoms to acquire two electrons in the valence shell is called:*
(a) duplet rule (b) triplet rule (c) octet rule (d) divalent rule

30. *In 1916 this chemist proposed the octet rule.*
(a) John Dalton (b) Chadwick (c) G.N. Lewis (d) Goldstein

31. *It plays an important role in determining the chemical properties of the atom, including its ability to form chemical bonds.*
(a) number of protons (b) number of neutrons
(c) electrons present in the innermost shell (d) electrons present in the outermost shell

32. *These electrons in the outermost shell of an atom are called:*
(a) valence electrons (b) outer electrons (c) Both 'a' & 'b' (d) None of them

33. *Electronic configuration of an element is $1s^2$, $2s^2$, $2p^1$, therefore the valence electrons this element has are:*
(a) one (b) two (c) three (d) five

34. *The valence electrons which are involved in chemical bonding are termed as:*
(a) valency electrons (b) bonding electrons
(c) reactive electrons (d) ionic electrons

35. *The group number in the periodic table indicates the:*
(a) number of valence electrons in an atom (b) total number of electrons in an atom
(c) number of protons in the nucleus (d) number of neutrons in the nucleus

36. *Sodium contains one electron in its valence shell so it belongs to:*
(a) group I (b) group II (c) group II (d) zero group

37. *Phosphorus belongs to group VA, so in the valence shell, it contains:*
(a) one electron (b) two electrons (c) three electrons (d) five electrons

38. *Chemical bonding is the combining of atoms to form:*
(a) new elements (b) new atoms (c) new substances (d) All of these

39. *An interaction that holds two atoms together is called a:*
(a) chemical bond (b) ionic bond (c) covalent bond (d) coordinate bond

40. *In the formation of an ionic bond, an atom loses electrons and changes into:*
(a) negative ion (b) positive ion (c) neutral atom (d) None of these

41. *The atom which gains electron changes into:*
(a) negative ion (b) positive ion (c) neutral atom (d) None of these

42. *The electrostatic force of attraction that holds the oppositely charged ions together is called:*
(a) chemical bond (b) ionic bond (c) covalent bond (d) coordinate bond

43 *Electrovalent bond is also known as:*
(a) chemical bond (b) ionic bond (c) covalent bond (d) coordinate bond

44. *Generally, an ionic bond is formed between the atoms of:*
(a) two same metals (b) two different metals
(c) two same groups (d) two different groups

45. *Sodium chloride, potassium chloride, magnesium fluoride are:*
(a) coordinate compounds (b) covalent compounds
(c) ionic compounds (d) None of these

46. *The electron arrangement of sodium atom is:*
(a) 2, 8, 0 (b) 2, 8, 1 (c) 2, 8, 2 (d) 2, 8, 3

47. *The electron arrangement of chlorine atom is:*
(a) 2, 8, 1 (b) 2, 8, 3 (c) 2, 8, 5 (d) 2, 8, 7

48. *The formula of magnesium oxide is:*
(a) MgO (b) MgO_2 (c) MgO_3 (d) Mg_2O

49. *The ionic bond between magnesium and oxygen is stronger than the ionic bond between sodium and chlorine because of the:*
(a) larger size of the atoms (b) larger size of cation
(c) greater charge on the ions (d) None of these

50. *A covalent bond between two atoms, is formed by the:*
- *(a)* electrostatic force between two ions
- *(b)* mutual sharing of electrons
- *(c)* only one of the atoms contributes both electrons constituting the bond
- *(d)* None of these

51. *The bond in MgO is:*
- *(a)* electrovalent bond
- *(b)* covalent bond
- *(c)* co-ordinate bond
- *(d)* chemical bond

52. *The electrons of atoms that pair up to form a chemical bond are called:*
- *(a)* pair electrons
- *(b)* ionic pair electrons
- *(c)* covalent pair electrons
- *(d)* bond pair electrons

53. *The formations of H_2, HCl, CH_4* are few examples of this type of bonding.
- *(a)* Electrovalent bond
- *(b)* Single covalent bond
- *(c)* Double covalent bond
- *(d)* Triple covalent bond

54. *Oxygen (O_2) and ethene (C_2H_4) are examples of this type of bonding.*
- *(a)* Electrovalent bond
- *(b)* Single covalent bond
- *(c)* Double covalent bond
- *(d)* Triple covalent bond

55. *It has 6 valence electrons in its outer shell.*
- *(a)* carbon
- *(b)* chlorine
- *(c)* sodium
- *(d)* oxygen

56. *Nitrogen (N_2) and ethyne (C_2H_2) are examples of this type of bonding.*
- *(a)* Electrovalent bond
- *(b)* Single covalent bond
- *(c)* Double covalent bond
- *(d)* Triple covalent bond

57. *In its outer shells, each nitrogen atom has:*
- *(a)* one electrons
- *(b)* two electrons
- *(c)* three electrons
- *(d)* five electrons

58 *The covalent bond formed between identical atoms is called:*
- *(a)* non-polar covalent bond
- *(b)* polar covalent bond
- *(c)* coordinate covalent bond
- *(d)* dative covalent bond

59 *The bond in a hydrogen molecule is:*
- *(a)* non-polar covalent bond
- *(b)* polar covalent bond
- *(c)* coordinate covalent bond
- *(d)* dative covalent bond

60. *Non-polar covalent bonds are formed when the electronegativities of the two atoms are:*
- *(a)* unequal
- *(b)* equal
- *(c)* zero
- *(d)* larger

61. *Bonds in HCl, H_2O, NH_3 are:*
- *(a)* non-polar covalent bond
- *(b)* polar covalent bond
- *(c)* coordinate covalent bond
- *(d)* dative covalent bond

62 *When the difference between electronegative values of two bonded atoms is more than 1.7, the bond will be purely:*
- *(a)* polar covalent
- *(b)* non-polar cobalent
- *(c)* ionic or electrovalent
- *(d)* covalent

63. *When the difference between electronegative values of two bonded atoms is less than 1.7, the bond will be:*
- *(a)* polar covalent
- *(b)* non-polar cobalent
- *(c)* ionic or electrovalent
- *(d)* covalent

64. *The bond will be pure covalent or non-polar if the electronegative difference of bonded atoms is:*
(a) zero (b) 1.7 (c) less than 1.7 (d) more than 1.7

65. *The type of bond in which bond pair of electrons is contributed by one atom only, is called a:*
(a) coordinate covalent (b) dative covalent bond
(c) Both 'a' & 'b' (d) None of these

66. *The reaction between ammonia and hydrogen chloride involves the formation of a/an:*
(a) ionic bond (b) covalent bond
(c) polar covalent bond (d) dative bond

67. *Most ionic compounds form:*
(a) liquids (b) crystals (c) gases (d) metals

68. *The melting and boiling points of ionic compounds are:*
(a) high (b) low (c) moderate (d) None of these

69. *Aqueous solutions of ionic compounds are:*
(a) non-conductor of electricity (b) conductor of electricity
(c) sometimes conduct electricity (d) partial conductor of electricity

70. *Ionic compounds usually dissolve in:*
(a) covalent solvent (b) ionic solvent (c) polar solvent (d) non-polar solvent

71. *Ionic compounds are insoluble in:*
(a) covalent solvent (b) ionic solvent (c) polar solvent (d) non-polar solvent

72. *Which one of these is polar solvent?*
(a) oil (b) water (c) petrol (d) kerosene oil

73. *As compared to ionic bond, covalent bonds are generally:*
(a) weak (b) strong (c) stable (d) unstable

74. *Sugar crystals and diamond are the examples of:*
(a) ionic compounds (b) covalent compounds
(c) polar compounds (d) non-polar compounds

75 *Non-polar covalent compounds are generally:*
(a) soluble in water (b) insoluble in water
(c) sometimes insoluble in water (d) sometimes soluble in water

76 *Polar covalent compounds are soluble in:*
(a) oil (b) water (c) petrol (d) kerosene oil

77. *They do not conduct electricity in the solid, molten or aqueous solution.*
(a) Ionic compounds (b) polar compounds
(c) non-polar compounds (d) All of these

78. *They are bad conductors of electricity.*
(a) covalent compounds (b) ionic compounds
(c) polar compounds (d) None of these

79. *Which one is a polar covalent compound?*
(a) CO_2 (b) CH_4 (c) C_2H_6 (d) HCl

80. *Which one is non-polar covalent compound?*
(a) H_2SO_4 (b) CO_2 (c) H_2O (d) HF

81. *It is a common white glue.*
(a) Polyurethane (b) Resin glue (c) Polyvinyl acetate (d) Epoxy resins

82. *It is used in the construction of vehicles, trucks, boats and aircraft.*
(a) Polyurethane (b) Resin glue (c) Polyvinyl acetate (d) Epoxy resins

Answers

01.	(d)	12.	(b)	23.	(c)	34.	(b)	45.	(c)	56.	(d)	67.	(b)	78.	(a)
02.	(a)	13.	(a)	24.	(d)	35.	(a)	46.	(b)	57.	(d)	68.	(a)	79.	(d)
03.	(d)	14.	(b)	25.	(c)	36.	(a)	47.	(d)	58.	(a)	69.	(b)	80.	(b)
04.	(c)	15.	(d)	26.	(a)	37.	(d)	48.	(a)	59.	(a)	70.	(c)	81.	(c)
05.	(c)	16.	(b)	27.	(d)	38.	(c)	49.	(c)	60.	(b)	71.	(d)	82.	(d)
06.	(a)	17.	(a)	28.	(b)	39.	(a)	50.	(b)	61.	(b)	72.	(b)		
07.	(b)	18.	(a)	29.	(a)	40.	(b)	51.	(a)	62.	(c)	73.	(a)		
08.	(a)	19.	(c)	30.	(c)	41.	(a)	52.	(d)	63.	(d)	74.	(b)		
09.	(b)	20.	(a)	31.	(d)	42.	(b)	53.	(b)	64.	(a)	75.	(b)		
10.	(c)	21.	(c)	32.	(c)	43.	(b)	54.	(c)	65.	(c)	76.	(b)		
11.	(c)	22.	(a)	33.	(c)	44.	(d)	55.	(d)	66.	(d)	77.	(c)		

Section B&C — Short & Detailed Answer Questions

Q.1 Define chemical bond or chemical forces.

Ans: ***Chemical Bond or Chemical Forces:*** All the matters in this world are composed of atoms. The attractive force which binds atoms together is called a chemical bond or chemical forces. Few elements also consist of un-bounded atoms. For instance, helium, neon, argon, xenon and krypton present in the atmosphere consist of un-bounded atoms. How various atoms are bonded together affects the properties of substances.

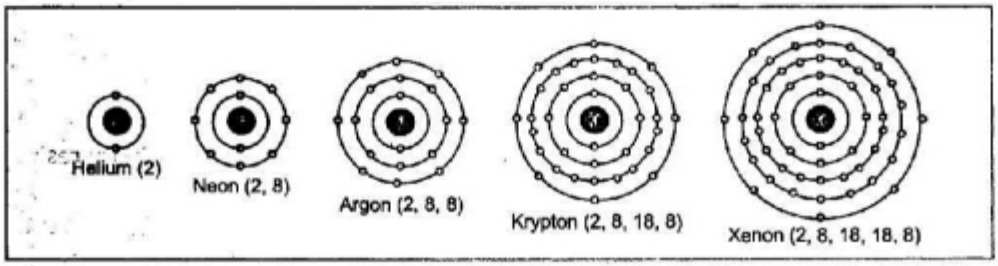
Chemical bonding is the combining of atoms to form new substances. An interaction that holds two atoms together is called a chemical bond. Atoms can lose, gain or share valence electrons to form chemical bonds.

Q.2 Why do atoms form chemical bonds?

Ans: The essential answer is that everyone in the world desires to be stable in their life. Atoms are just like that, they are also trying to become more stable, so atom tries to shares some electrons with each other to obtain the electronic configurations of noble gases.

Q.3 Describe the electronic configuration of noble gases.

Ans: Noble gases have ns^2 np^6 electronic configuration in the outermost shell and rarely form chemical bonds. The noble gases are helium (He), Neon (Ne), Argon (Ar), Krypton (Kr), Xenon (Xe) and Radon (Rn). These elements are sometimes called inert gases. This is because they do not participate in chemical reactions. The outer shells of three noble gas atoms are shown in the following figure.



Note that these elements have a completely filled outermost shell. Helium contains 2 electrons and other noble gases contain 8 electrons in the valence shell. Because of these electronic configurations of noble gases are stable and not active.

Duplet and Octet Rules: Atoms to acquire two electrons in the valence shell is called the duplet rule, whereas atoms to acquire eight electrons in the valence shell is called the octet rule. In 1916 a chemist G.N. Lewis used this fact, why atoms undergo chemical reactions. He called his explanation the octet rule. An octet means a set of eight.

Q.4 ***What are valence electrons? OR Where are valence electrons located? And why are they important?***

Ans: Electrons present in the outermost shell of an atom play an important role in determining the chemical properties of the atom, including its ability to form chemical bonds. These electrons in the outermost shell of an atom are called valence electrons or outer electrons.

Q.5 ***How can we find the number of valence electrons? OR Where are valence electrons located?***

Ans: Finding valence electron or the electron configuration consider an example of Boron (B), which has electronic number five. The electronic configuration looks like this: $1s^2$, $2s^2$, $2p^1$ since there are three electrons in the second shell ($2s^2$ and $2p^1$), we can say boron has **three** valence electrons.

We know that the group number indicates the number of valence electrons in an atom. For example, sodium belongs to group I, so it contains one electron in its valence shell. Similarly, phosphorus belongs to group VA, so it contains five electrons in the valence shell.

Q.6 ***What is meant by bonding electrons?***

Ans: The valence electrons which are involved in chemical bonding are termed bonding electrons.

Q.7 ***When atoms are considered to be unstable?***

Ans: An atom can be considered unstable in one of two ways. If it picks up or loses an electron, it becomes electrically charged and highly reactive. Such electrically charged atoms are known as ions. Instability can also occur in the nucleus when the number of protons and neutrons is unbalanced. To achieve equilibrium, the atom emits particles in the form of radiation until the nucleus is stable. Such unstable atoms are said to be radioactive.

Q.8 ***Name the types of chemical bonds.***

Ans: There are three types of bonds depending on the tendency of an atom to lose or gain or share electrons.

(i) Ionic Bond (ii) Covalent Bond (iii) Co-ordinate covalent bond or dative covalent

Q.9 ***Describe the formation of ionic bonds.***

Ans: ***Formation of Ionic Bonds:*** In the formation of an ionic bond, an atom loses electrons and changes into a positive ion (cation) whereas another atom gains this electron and changes into a negative ion (anion). These cations and anions have opposite charges. They attract one another by the electrostatic force of attraction. The force of attraction that holds the oppositely charged ions together is called an ionic bond or electrovalent bond.

Generally, an ionic bond is formed between the atoms of two different groups, metal and non-metal.

Q.10 ***Define ionic compounds.***

Ans: *Ionic Compounds:* Compounds that contain ionic bonds are called ionic compounds such as sodium chloride, potassium chloride, magnesium fluoride etc.

Q.11 ***Explain the formation of ionic bond in:***

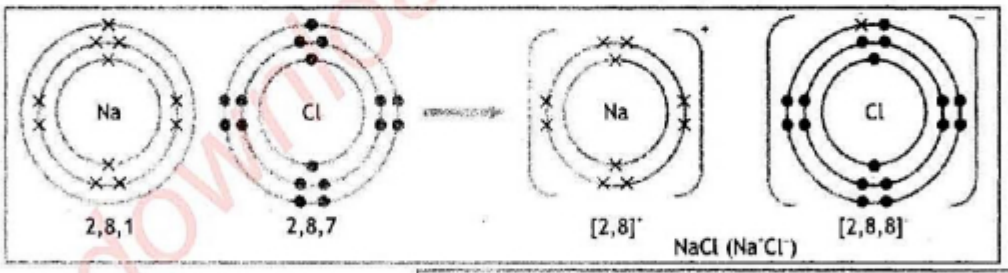
(1) the reaction between sodium and chlorine
(2) the reaction between magnesium and oxygen

Ans: (a) The Reaction between Sodium and Chlorine: Sodium atom is a metal of IA group of the periodic table and has only one electron in the outermost shell. The electron arrangement of the sodium atom is 2, 8, 1. By losing one electron from the outermost shell, sodium forms cation (Na^+) whereas chlorine atom is non-metal of VIIA group and has seven electrons in its outermost shell. The electron arrangement of the chlorine atom is 2, 8, 7. Since the chlorine atom has seven electrons in its outermost shell, it needs one electron to complete the octet. By gaining one electron, the chlorine atom now has eight electrons in its outermost shell and a chloride ion is formed (Cl^-).

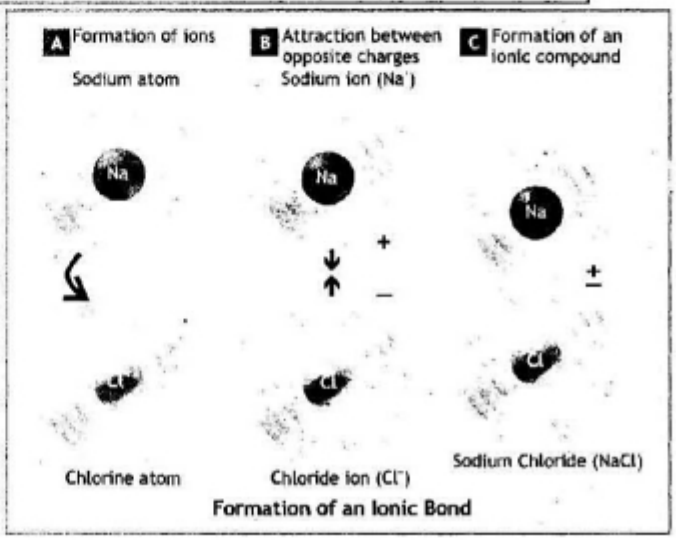
Na	$Na^+ + e$
2,8,1	2,8
$Cl + e$	Cl^-
2,8,7	2,8,8

(Sodium chloride)

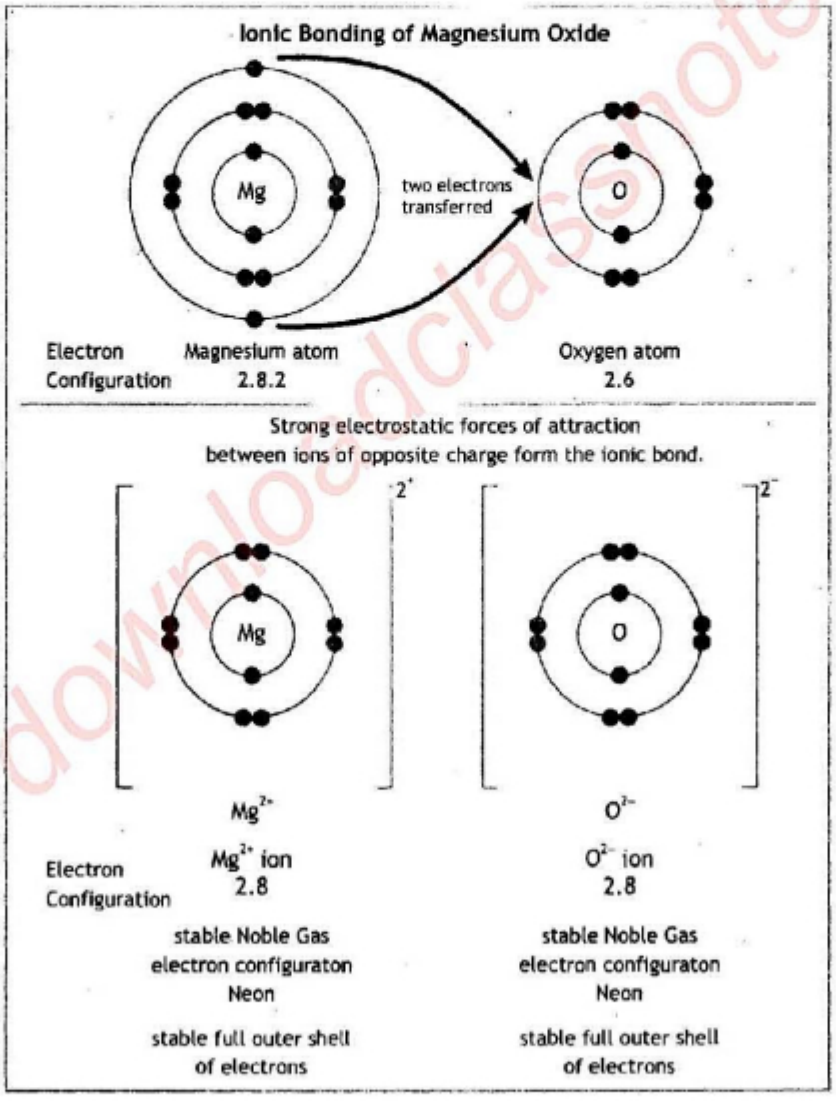
Both these atoms are now oppositely charged ions. Therefore two charged ions are attracted to each other by the electrostatic force of attraction. Thus Na^+ and Cl^- ions are joined by an ionic bond and form sodium chloride. The formation of ionic bonds by a 'dot and cross' diagram is shown in the following figure.



Formation of ionic bond in Sodium chloride



(b) ***The Reaction between Magnesium and Oxygen:*** We consider another example of ionic bond formation, the reaction between magnesium and oxygen forming magnesium oxide. Magnesium is in the group-II of the periodic table and has only two electrons to share and oxygen is in group VIA and has six electrons in its outermost shell. By losing two electrons from the outermost shell, magnesium becomes Mg^{2+} and it is left with 8 electrons in the second shell. By gaining two electrons, the oxygen atom now also has eight electrons in its outermost shell and becomes O^{2-}. Both these atoms are now changed into oppositely charged ions. The attraction between the oppositely charged ions forms the ionic bond between magnesium and oxygen. The formula of magnesium oxide is MgO. The formation of ionic bonds by a 'dot and cross' diagram is shown in the following figure.



Formation of ionic bond in Magnesium oxide

The ionic bond between magnesium and oxygen is stronger than the ionic bond between sodium and chlorine because of the greater charge on the ions. Magnesium oxide has a higher melting point due to the presence of a stronger bond.

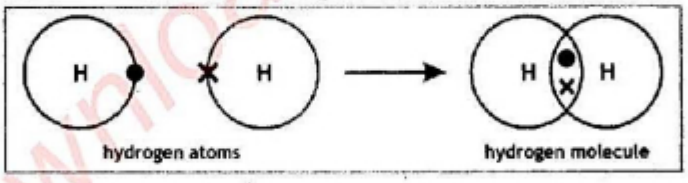
DO YOU KNOW?

- The alkali metals (IA group elements) lose a single electron to form a monovalent cation.
- The alkaline earth metals (IIA group elements) lose two electrons to form a divalent cation (M^{++}).
- Aluminium, a member of the IIIA family, loses three electrons and form a trivalent cation (M^{+++}).
- The halogens (VIIA group elements) have seven valence electrons. All the halogens gain one electron to complete their valence energy level. And all of them form an anion with a single negative charge.
- The VIA elements gain two electrons and form divalent anions (e.g. O^{2-}, S^{2-}).
- The VA elements gain three electrons and form trivalent anions (e.g. N^{3-}, P^{3-}).

Q.12 *Define covalent bond. Explain the formation of a covalent bond with an example.*

Ans: ***Covalent Bond:*** In this type of bond, electrons are not gained or lost by atoms. A covalent bond is formed by the mutual sharing of electrons between two atoms. This type of bonding occurs between two atoms of the same element or atoms of different elements. This bonding occurs primarily between nonmetals; however, it can also be observed between metals and non-metals.

Example: Consider the formation of a covalent bond between two hydrogen atoms. Hydrogen belongs to group IA and has one electron in its valence shell. When two hydrogen atoms share their valence electrons, both atoms achieve the electronic configuration of noble gas and satisfy the duplet rule.



A covalent bond is generally represented by a short straight line (–) between two bonded atoms. The above figure shows the formation of a covalent bond by a 'dot' and 'cross' diagram.

Q.13 *Define the following terms:*

(a) Unpaired electrons (b) electron pair (c) bond pair (d) lone pair

Ans:
(i) Unpaired Electron: When there is one electron in a sub-orbital, it is called an unpaired electron.
(ii) Electron Pair: When the sub-orbital is filled with a maximum of two electrons, it is called an electron pair. The electron pairs can be found in two types as bond pair and lose pair.
(iii) Bond Pair: Bond pair is composed of two electrons that are in a bond.
(iv) Lone Pair: Lone pair is composed of two electrons that are not in a bond.

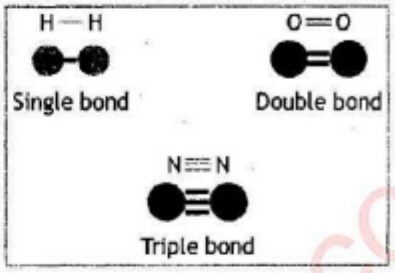
Q.14 *How many types of covalent bond are there? Write the name.*

Ans: ***Types of Covalent Bond:*** As we know that the covalent bond is formed by the mutual sharing of electrons between two atoms. The electrons of atoms that pair up to form a chemical bond are called bond pair electrons. Depending upon the number of bond pair, a covalent bond is further classified into three types.

(i) Single Covalent Bond (ii) Double Covalent Bond
(iii) Triple Covalent Bond

We can simply define three types of a covalent bond as:

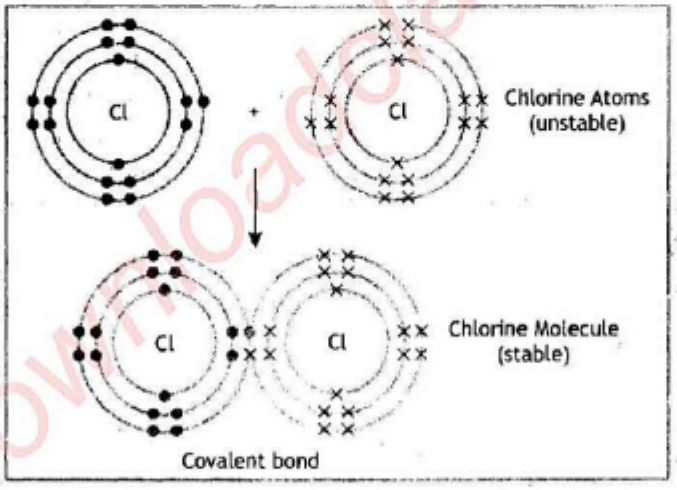
- Mutual sharing of two electrons between two atoms form a single covalent bond.
- Mutual sharing of four electrons between two atoms form a double covalent bond.
- Mutual sharing of six electrons between two atoms form a triple covalent bond.



Q.15 *Explain a single covalent bond with examples.*

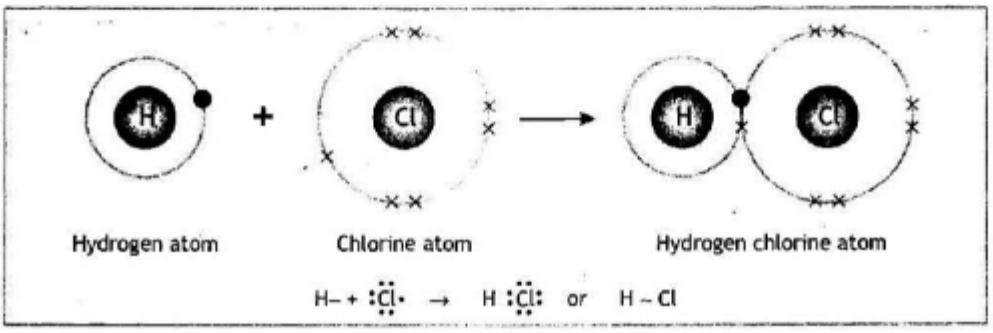
Ans: *Single Covalent Bond (–):* A covalent bond that is formed by the mutual sharing of one bond pair is called a single covalent bond and it is represented by a single short straight line. The formations of H– H, H-Cl, CH_4 are few examples of this type of bonding.

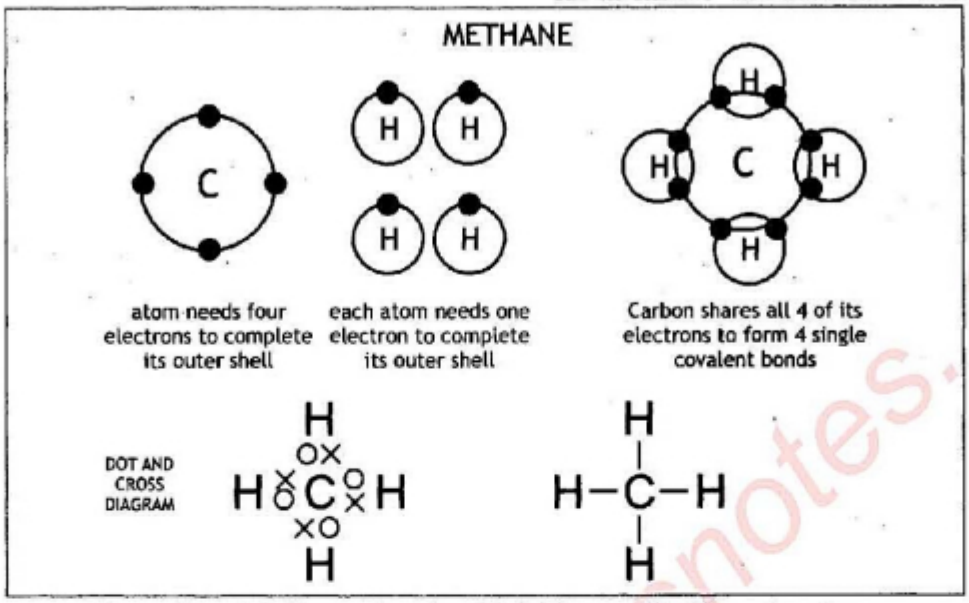
Examples – Formation of Chlorine Molecule: A chlorine atom belongs to group VIIA and it has seven outer electrons. It needs one more electron to achieve a stable octet electronic configuration. When two chlorine atoms share their valence electrons, both atoms achieve the electronic configuration of a noble gas. The single bond in the chlorine molecule is represented by a dot and cross diagram as shown in the following figure.



Formation of single covalent bond in a chlorine molecule

Some other examples of the formation of a single covalent bond in hydrogen chloride and methane can be represented as follows:



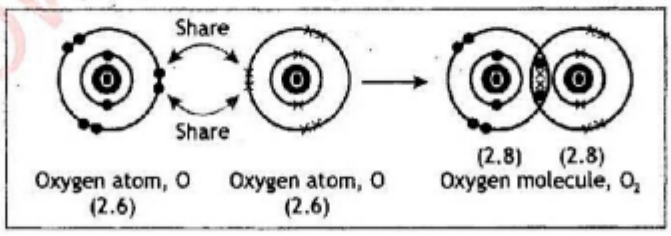


Formation of single covalent bond in hydrogen chloride and methane

Q.16 Describe the double covalent bond with examples.

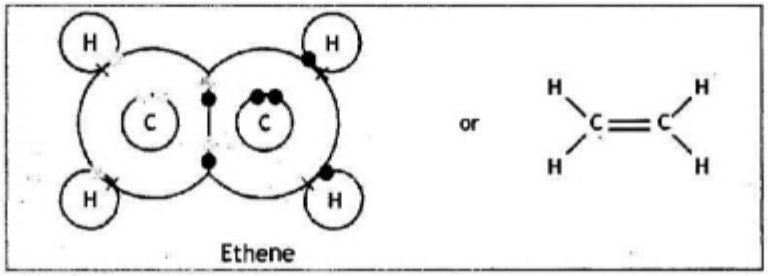
Ans: ***Double Covalent Bond (=):*** A covalent bond is formed by the mutual sharing of two bond pairs called a double covalent bond and it is represented by two short straight lines. The examples of molecules having double bonds are oxygen (O_2) and ethene (C_2H_4).

Example – Formation of Oxygen Molecule: The oxygen atom belongs to group VIA of the periodic table and it has 6 valence electrons in its outer shell. It needs two more electrons to achieve a stable octet electronic configuration. Each oxygen atom will share two of its outer electrons with another oxygen atom to form an oxygen molecule (O_2). Thus, two pair of electrons are shared between the two oxygen atoms to form a double covalent bond. The double covalent bond in an oxygen molecule is represented by a dot and cross diagram as shown in the following figure.



The structural formula of an oxygen molecule is written O = O

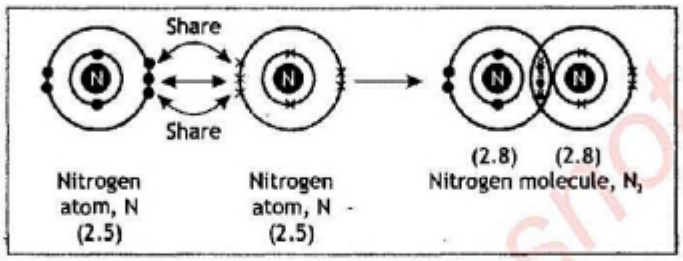
Another example of a double covalent bond in ethene molecule can be represented as follows:



Q.17 Explain triple covalent bond with examples.

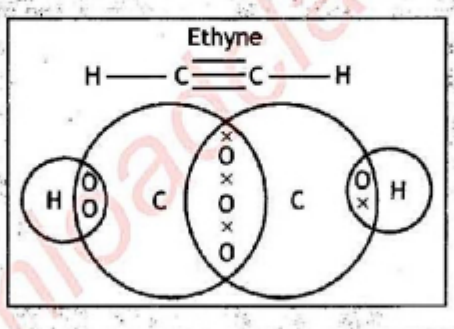
Ans: ***Triple Covalent Bond:*** A covalent bond that is formed by the mutual sharing of three bond pairs is called a triple covalent bond and it is represented by three short straight lines (N ≡ N). For example, nitrogen (N_2) and ethyne (C_2H_2).

Example – Formation of Nitrogen Molecule: Nitrogen is a non-metal. Each nitrogen atom has five electrons in its outer shells. Two nitrogen atoms will share three electrons to form three covalent bonds which are called triple covalent bond and formed a nitrogen molecule (N_2). The triple bond in nitrogen molecule is represented by dot and cross diagram is shown in the following figure.



The structural formula of a nitrogen molecule is N ≡ N.

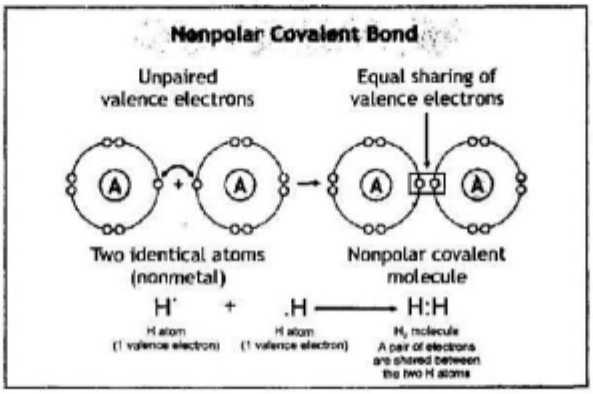
Another example of triple covalent bond in ethyne molecule can be represented as follows:



Q.18 Under what conditions are the polar and non-polar covalent formed?

Ans: Covalent bonds are formed between two similar and dissimilar atoms. For example, H – H, O = O, N ≡ N, H – Cl.

Non-polar Covalent Bond: The covalent bond formed between identical atoms is called non-polar covalent bond. Both the identical atoms exert some force on the shared electron pairs. A non-polar covalent bond in hydrogen molecule is shown below:

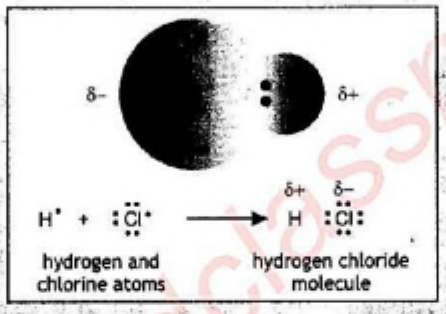


In the above example, each H atom has an equal electronegativity value of 2.1, therefore the covalent bond between them is considered non-polar. It means non-polar covalent bonds are formed when the electronegativities of the two atoms are equal.

Polar Covalent Bond: On the other hand, when different atoms share electron pair, both the atoms exert unequal forces on the shared electron pair. Such a covalent bond is called a polar covalent bond. For example, bond in HCl, H_2O, NH_3 are polar covalent bonds.

In the formation of a polar covalent bond, one of the atoms will attract the shared electron pair more strongly than the other one. This atom will be called a more electronegative atom. So, the more electronegative atom partially draws electron towards itself, this makes it partially negatively charged and another atom partially positively charged.

For example, in hydrogen chloride, Cl is more electronegative than hydrogen. This causes the Cl atom to acquire a slight negative charge, and the H atom a slight positive charge due to electronegative difference. Thus, the bond between hydrogen and chlorine is called a polar covalent bond.



The compounds which have polar covalent bonds are called polar compounds.

Electronegative values determine whether a chemical bond will be ionic or covalent in nature. When the difference between electronegative values of two bonded atoms is more than 1.7, the bond will be purely ionic or electrovalent, whereas the difference is less than 1.7, the bond will be covalent. If the electronegative difference of bonded atoms is zero, the bond will be pure covalent or non-polar.

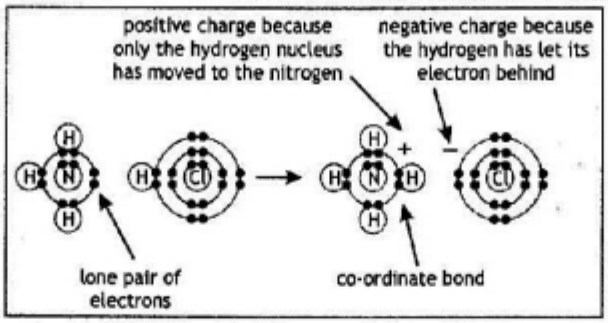
Q.19 *What is a coordinate covalent or dative covalent bond? Explain with example.*

Ans: ***Coordinate Covalent Bond or Dative Covalent Bond:*** We know that each atom contributes one electron to form a covalent bond. However, a covalent bond can be formed between two atoms even when only one of the atoms contributes both electrons constituting the covalent bond. Such a bond is called a coordinate covalent bond or dative bond. Thus, we can define a coordinate covalent bond as: The type of bond in which bond pair of electrons is contributed by one atom only is called a coordinate covalent or dative covalent bond.

Concept of Donor and Acceptor: The atom that donates the electron pair is called the donor and the other atom which accepts the electron pair is called the acceptor.

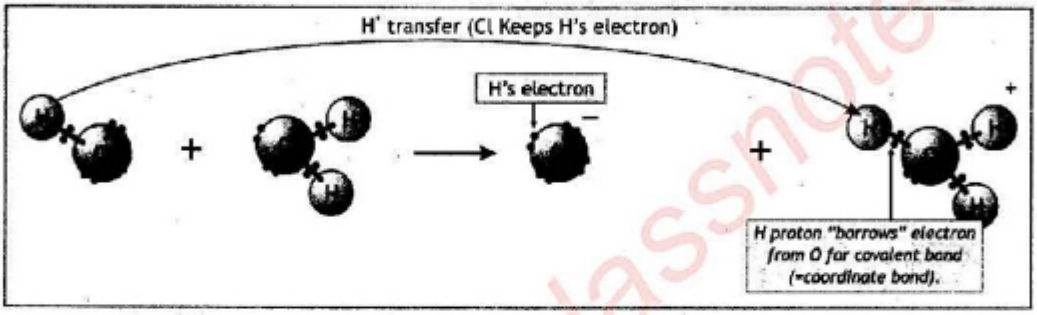
A coordinate covalent bond is represented by an arrow (→) pointing towards the atom which accepts the electron pair. A few examples of the formation of a coordinate covalent bond are given as under:

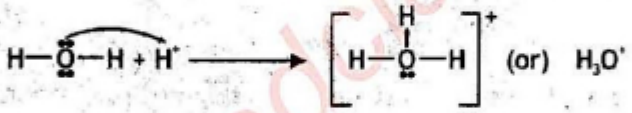
Example – Reaction between Ammonia and Hydrogen Chloride: The reaction between ammonia and hydrogen chloride involves the formation of a dative bond between N atom in NH_3 containing lone pairs and H^+ ion from HCl. When ammonia reacts with hydrogen ions (H^+) in an aqueous solution of an acid, the hydrogen ion is attracted to the lone pair and a coordinate covalent bond is formed.



The reaction between Ammonia and Hydrogen Chloride

When hydrogen chloride dissolves in water, a hydrogen ion is attracted to the lone pair of electrons which is available on oxygen and hydronium ion is formed as shown below:

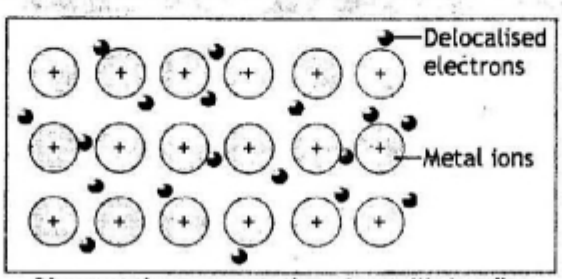




Once a bond is formed, it is impossible to tell any difference between the dative covalent and ordinary covalent bonds. There is no difference between them in reality. The only difference between the two is a mode of formation. Due to their covalent nature of the bond formation, the properties of these compounds are similar to those of covalent compounds.

Q.20 *Describe metallic bond.*

Ans: ***Metallic Bond:*** Metallic bonds are formed by the attraction between metal ions and delocalized or "mobile" electrons as shown in the following.



Diagramatic representation of metallic bonding

- Metal atoms lose the outer shell electrons and become positively charged ions and occupy a fixed position in a lattice.
- The outer shell electrons are free to move between the metal ions so are called delocalized and move freely.
- Thus the metal lattice structure shows positively charged ions surrounded by a delocalized outer electron.

Q.21 ***Magnesium is present in which group? How many electrons are in the outer shell of a magnesium atom?***

Ans: Magnesium is present in group 2 and period 3. It is a s-block element. Its atomic number is 12 and it is solid at 20°C. Its electronic configuration is $1s^2 2s^2 2p^6 3s^2$ so it has two electrons in its outer shell.

Q.22 ***What is the charge of a magnesium ion and what is its symbol?***

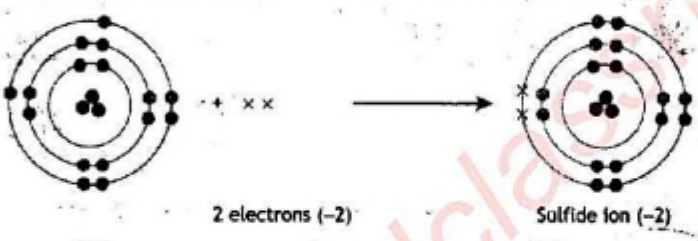
Ans: The charge of a magnesium ion is +2 and the symbol for the ion is Mg^{2+}.

Q.23 ***Does an ionic bond have a dipole?***

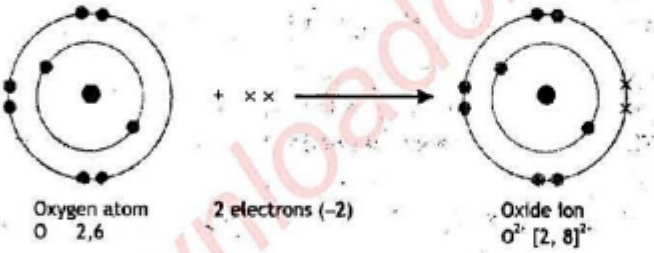
Ans: An ionic bond does not have a dipole because a dipole is, by definition, a polar molecule.

Q.24 ***Describe the formation of anions for the following non-metals using dot cross structure:***
(a) Sulphur (atomic number 16) (b) Oxygen (atomic number 8)

Ans: (a)

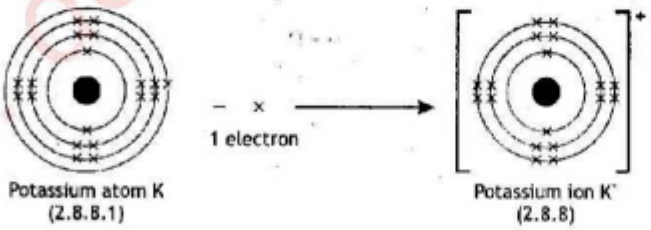


(b)

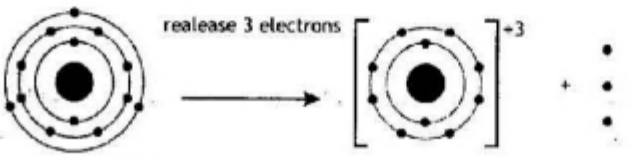


Q.25 ***Write the formation of cations for the following metal atoms using dot cross structure:***
(a) K (atomic number 19) (b) Al (atomic number 13)

Ans: (a)



(b)

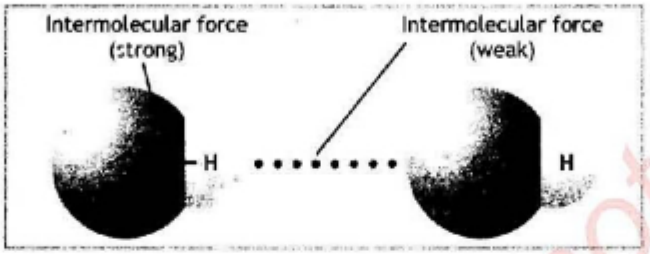


● : electron

Number of proton = 13	Number of proton = 13
Number of electrons = 13	Number of electrons = 10
Charge = 0 (Neutral)	Charge = +3

Q.26 What do you know about intermolecular forces?

Ans: ***Intermolecular Forces:*** We know that some forces which hold the atoms together in a substance are called chemical bonds. Moreover, along with these strong bonding forces, weak forces are also created in between the molecules. These are called intermolecular forces. Thus, Intermolecular forces are defined as the set of all the forces that occur between two neighbouring molecules. The bonding and intermolecular forces of hydrochloric acid are shown below:



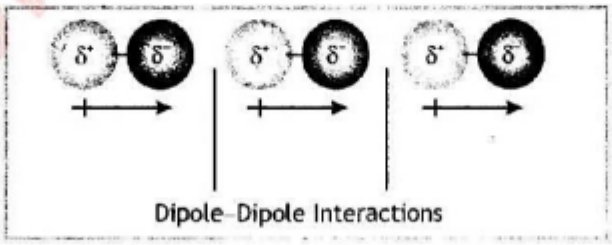
These intermolecular forces are weaker than an ionic and covalent bond. The interaction between intermolecular forces may be used to describe how molecules interact with each other. The strength or weakness of intermolecular forces determines the states of matter of a substance (e.g., solid, liquid, gas) and some of the chemical properties (e.g., melting point, structure).

There are several types of intermolecular forces, but two main intermolecular forces are:

(i) Dipole–Dipole Interaction (ii) Hydrogen bonding

Q.27 Explain dipole-dipole interaction forces with examples.

Ans: ***Dipole–Dipole Interaction:*** Dipole–Dipole interactions result when the two dipolar molecules interact with each other. When the partially negative portion of one of the polar molecules is attracted to the partially positive portion of the second polar molecule, the electrostatic attraction is created between two molecules. These attractive forces are called Dipole-Dipole interactions and represented as below:



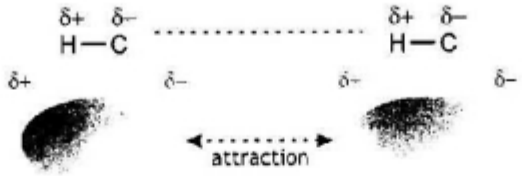
Dipole–Dipole Interactions

In the diagram, "δ" (read as "delta") means "slightly".

Example Dipole–Dipole Interaction: Dipole–dipole interaction can be seen in hydrogen chloride. Chlorine atoms are much more electronegative than hydrogen atoms. A partial negative charge is created on chlorine and in turn a partial positive charge on hydrogen due to electronegative difference.

$\overset{\delta+}{H}-\overset{\delta-}{Cl}$

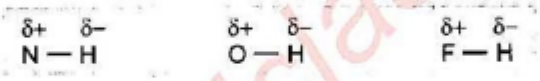
When two molecules of hydrogen chloride come close to each other, the slightly negative end of one molecule is attracted to the slightly positive end of another molecule. These attractive forces are simply called dipole-dipole interaction as represented below:



Q.28 ***What is hydrogen bonding?***

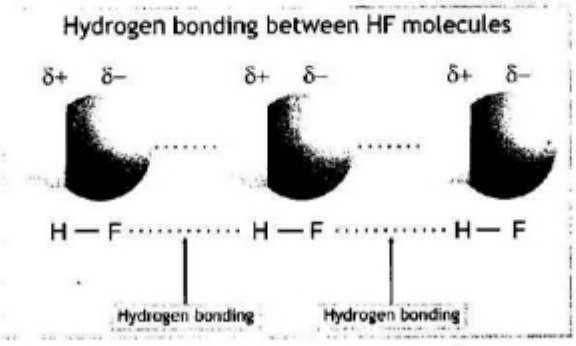
Ans: ***Hydrogen Bonding:*** A hydrogen bond is a type of dipole-dipole interaction. When hydrogen forms polar covalent with more electronegative atom like Nitrogen (N), Oxygen (O), Fluorine (F), Chlorine (Cl), Sulphur (S), then hydrogen gets a partial positive charge and other electronegative atoms get a partially negative charge. The interaction between the partially positive charged hydrogen atom of one molecule with an electronegative atom of another molecule is called a Hydrogen bond.

In molecules containing N–H, O–H or F–H bonds, the large difference in electronegativity between the H atom and the N, O or F atom leads to a highly polar covalent bond. Because of the difference in electronegativity, the H atom bears a partial positive charge and the N, O or F atom bears a partial negative charge. (δ^+ and δ^- show slight charges).



The high partial positive charge on the H atom enables to attract of the highly electronegative (N, O, or F) atom of the other molecule.

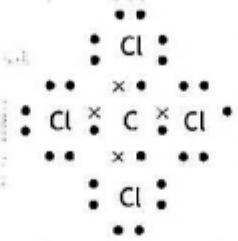
Example of Hydrogen Bonding: Consider the example of hydrogen fluoride. The fluorine atom is more electronegative. They tend to pull on the shared pair of electrons, creating a partial negative charge on themselves and a partial positive charge on the hydrogen. The partial positive charge bearing hydrogen, then forms a bond with the electronegative atom of a neighbouring molecule, while its electronegative element forms another bond with the positive hydrogen of another neighbouring molecule. Therefore, several molecules combine by hydrogen bonding thus:



These intermolecular forces are extremely important in determining the properties of water, biological molecules, such as proteins, DNA. Synthetic material such as glue, paints and dyes are developed due to hydrogen bonding. Synthetic resins bind two surfaces together by hydrogen bonding or dipole-dipole interaction. Moreover, hydrogen bonding affects the physical properties of the molecules like melting and boiling point, density, solubility etc.

Q.29 ***Write the cross structure of CCl_4.***

Ans:



Q.30 ***Represent the formation of anions by the following non-metals using electron 'dot' and cross' structure.***

(i) N (ii) Br (iii) P

Ans: (I) $\cdot\ddot{N}\cdot + \therefore \longrightarrow [:\ddot{N}:]^{3-}$ (ii) $:\ddot{Br}\cdot + \times \longrightarrow [:\ddot{Br}:]^{-1}$

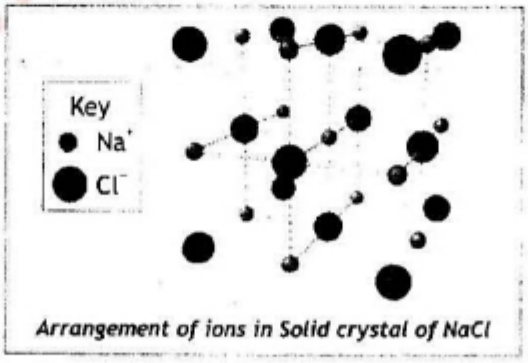
(iii) $\cdot\ddot{P}\cdot + \therefore \longrightarrow [:\ddot{P}:]^{3-}$

Q.31 ***On what do the properties of compounds depend?***

Ans: The losing or gaining of electrons leads to ionic bonding; while the sharing of electrons leads to covalent. The properties of the compounds depend upon the nature of bonds existing between them.

Q.32 ***Define ionic compounds. What are the characteristics of ionic compounds?***

Ans: ***Ionic Compounds:*** Compounds having ionic bonds are called ionic compounds. The properties of ionic compounds relate to how strongly the positive and negative ions attract each other in an ionic bond. Most of the ionic compounds are in a solid or crystal form with strong electrostatic forces. The following figure shows the arrangement of Na^+ and Cl^- ions in NaCl. In the crystal structure of sodium chloride, each Na+ ion is surrounded by six Cl– ions. Similarly, each Cl– ion is surrounded by six Na+ ions.



Arrangement of ions in Solid crystal of NaCl

Characteristics of Ionic Compounds: The ionic compounds exhibit the following properties:

(I) Ionic compounds form crystals.

(II) Ionic compounds tend to be hard and brittle

(III) The large attracting forces result in a very stable structure. Therefore a lot of energy will be required to break these forces. So ionic compounds have high melting points. For example, the melting point of NaCl is 801°C and boiling point 1413°C.

(iv) Aqueous solutions of ionic compounds also conduct electricity. This is because when an ionic compound dissolves in water, the ions are free to move in an aqueous solution.

(v) Ionic compounds usually dissolve in polar solvent like water and are insoluble in non–polar solvents like oil, petrol, kerosene oil etc.

Q.32 ***How are covalent compounds formed? Give the characteristics of covalent compounds.***

Ans: *Covalent Compounds:* Covalent compounds are formed by the mutual sharing of electrons between atoms. As the bonding force of covalent bonds is generally weak as compared to the ionic bond.

Characteristics of Covalent Compounds: The covalent compounds have the following properties:

(i) Covalent compounds can exist as crystals, examples include sugar crystals and diamond.

(ii) The melting and boiling points of most covalent compounds are usually low.

(iii) They are bad conductors of electricity.

(iv) They are insoluble in water, but soluble in non-polar solvents like oil, petrol, kerosene, etc

Q.33 ***What do malleable and ductile mean?***

Ans: *Malleable:* It means that metals can be hammered into different shapes and rolled into a sheet.
Ductile: It is the property through which metal can be drawn into wires.

Q.34 ***What are the characteristics of metals?***

Ans: *Characteristics of Metals:* Following are the different properties of metals such as:

(i) Metals are usually malleable and ductile.

(ii) They are the conductor of electricity and heat due to the presence of delocalized electrons (mobile electrons).

(iii) Melting and boiling points of metal are usually high as the atoms in metals are packed tightly.

(iv) Metals have high densities.

Q.35 ***What are the uses of different synthetic adhesives like glue and epoxy resins?***

Ans: Synthetic adhesives like epoxy resins and glues are the substance that sticks to the surface of the other objects. The material like plastic, wood, metal, ceramic glass and rubber etc on which glue is applied are called a substrate. Epoxy adhesive is more expensive as compared to resin glue. Both are synthetic adhesives and require mixing before use, but epoxy hardens much faster than resin glue. We can use adhesive anytime to reattach the broken objects. For example, Polyvinyl acetate is a common white glue. It is used in bookbinding. Polyurethane glue is a flexible adhesive. It is used in fixing soles to the bodies of shoes and woodworking. Natural rubber bond to substrate on contact. It is used in self-adhesive envelopes. Conductive adhesive is commonly used in electronics to repair equipment. Amino resins are water-soluble adhesive, they are used in the bonding of layers in plywood. Epoxy glue contains epoxy. Its form strong bonds with glass, plastics, plywood, laminated boards and ceramic. Another use for epoxy resin is decorative flooring applications. Commonly, epoxy resins are used where water resistance is required. Bridges, dams, power stations are also coated with epoxy resins.

Q.36 ***Explain how Aircrafts, cars, trucks and boats parts are partially held together with epoxy adhesive.***

Ans: The excellent adhesive properties of epoxy resins are due to the attractive forces between the epoxy resin and the surface of the substrate. One of the most common uses of epoxy resin is for adhesive purposes. For that purpose, epoxy resin is used in the construction of vehicles, trucks, boats and aircraft. Its drying time is 6-30 minutes hardly.

Q.37 ***How is an electronegative value determined the formation of a chemical bond?***

Ans: The electronegativity determines the nature of the bonding in a compound, from non–polar to ionic.

Explanation: A chemical bond forming a compound occurs when the atoms "share" electrons. Electronegativity determines the nature of the "sharing" of the electrons in the chemical bond. If the Electronegativity is very close to the same between the two atoms the electrons are shared roughly evenly. Each atom will have close to 50% of the electron density. This equal or close to equal sharing results in a non–polar bond.

If the electronegativity is very different between the two atoms, the electrons are shared very unevenly. One atom (or polyatomic ion) will the vast majority of the electron density. The other atom (or polyatomic ion) will have very little electron density. This will result in one atom having a positive charge and the other atom having a negative charge. This type of unequal sharing results in an ionic bond.

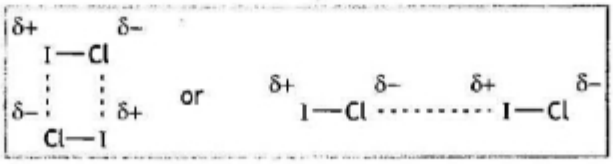
A polar covalent bond comes from atoms that have a difference in electronegativity but not as great as the differences in an ionic bond. In a polar covalent bond, one atom will have a partial positive charge and the other atom will have a partial negative charge.

Therefore, electronegativity describes the degree to which an atom attracts electrons in a chemical bond. The difference in the electronegativity of two atoms determines their bond type. If the electronegativity difference is more than 1.7, the bond will have an ionic character. If the electronegativity difference is between 0.4 and 1.7, the bond will have a polar covalent character. Lastly, if the electronegativity difference is less than 0.4, the bond will have a nonpolar covalent character.

Q.38 ***Describe dipole-dipole forces.***

Ans: ***Dipole–dipole Forces:*** Dipole–dipole forces are attractive forces between the positive end of one polar molecule and the negative end of another polar molecule. They are much weaker than ionic or covalent bonds and have a significant effect only when the molecules involved are close together (touching or almost touching).

The figures show two arrangements of polar iodine monochloride (ICl) molecules that give rise to dipole–dipole attractions.



- Polar molecules have a partial negative end and a partially positive end.
- The partially positive end of a polar molecule is attracted to the partially negative end of another.
- In a ICl molecule, the more electronegative chlorine atom bears the partial negative

charge; the less electronegative iodine atom bears the partial positive charge.

- The partially positive iodine end of one ICl molecule is attracted to the partially negative chlorine end of another ICl molecule.

A dashed line is used to represent an intermolecular attraction between molecules because these forces are NOT as strong as chemical bonds.

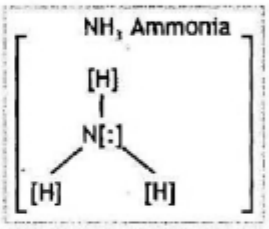
Q.39 How is hydrogen bonding affecting the physical properties of compounds?

Ans: The presence of hydrogen bonding will lift the melting and boiling points. The larger the molecule the more van der Waals attractions are possible - and those will also need more energy to break.

Most molecular substances are insoluble (or only very sparingly soluble) in water. The compounds having hydrogen bonding show abnormally high melting and boiling points. The high melting and boiling point of the compound containing hydrogen bonds is due to the fact that some extra energy is needed to break these bonds.

Q.40 How are electrons arranged in molecular compounds?

Ans: We consider drawing the Lewis structure of the covalent compound in question, putting the atom which is the least electronegative (save hydrogen) in the centre.



We draw a Lewis structure of the molecular compound in question to see how its constituent atoms are arranged.

To draw Lewis structures, we count the number of valence electron about each constituent atom and place the atom which is least electronegative in the centre of the compound.

However that this is not necessarily the same in the case of ionic compounds, where the formula given is instead the formula unit (the simplest repeating structure within the crystal lattice) and not the molecular formula of the entire compound.

Q.41 What do you understand by the ionic character of a covalent bond?

Ans: *Ionic Character in a Covalent Bond:* When a covalent bond is formed between two dissimilar atoms, e.g between H and Cl, the more electronegative atom (Cl) attracts the shared pair of electrons towards itself more than the less electronegative atom (H). Thus a partial negative charge comes on the chlorine atom and a partial positive charge comes on the hydrogen atom. These charges are also called poles. The polarity of a covalent bond depends on the difference in the electronegativities of the bonded atoms.

e.g. $\overset{+\delta}{H}—\overset{-\delta}{Cl}$

Q.42 Classify the following bonds as ionic or covalent. For those bonds that are covalent indicate whether they are polar or non-polar.

Ans: *Covalent Bonds:*

(a) H_2 *(non-polar)* *(b)* *HCl (polar)* *(c)* *HC ≡ CH (non-polar)*

$H—H$ $\quad$ $\overset{+\delta}{H}—\overset{-\delta}{Cl}$

(d) $O=O$ *(non-polar)*

Ionic Bonds: *(e)* NaCl *(f)* $CaCO_3$

Differences

1. ***Differentiate the properties of polar and non-polar compounds:***

Ans: ***Difference Between Polar and Non-polar Compounds***

Polar Compounds	*Non-polar Compounds*
Polar covalent compounds are soluble in water.	Nonpolar covalent compounds are generally insoluble in water.
Polar covalent compounds usually conduct electricity due to the formation of ions with water.	Non-polar covalent compounds do not conduct electricity in the solid, molten or aqueous solution.
Polar covalent compounds are insoluble in a non-polar solvent.	Non-polar covalent compounds are soluble in a non-polar solvent like petrol, benzene etc.
Few examples of polar covalent compounds are H_2SO_4, H_2O, HCl, HF, HBr, HI	Few examples of non-polar covalent compounds are CO_2, CH_4, C_2H_6.

2. ***What is the difference between lone pair and bond pair?***

Ans: ***Difference Between Lone pair and Bond Pair***

Bond Pair	*Lone Pair*
Bond pair is a pair of electrons that are in a bond.	Lone pair is a pair of electrons that are not in a bond.
They are always in bonds.	They are not in bonds but can form bonds by donating the lone pairs.
In a bond pair, the two electrons belong to two atoms.	In a lone pair, the two electrons belong to the same atom.
A bond pair is created due to sharing of electrons by two atoms.	A lone pair is created due to the absence of empty orbitals.

3. ***How does anion differ from an atom?***

Ans: ***Difference Between Anion and an Atom***

Atom	*Anion*
It is the smallest unit of an element.	An anion may be defined as an atom or molecule that is negatively charged.
Atoms are not independent in solution.	They are independent in solution.
Atoms form molecule.	With cations, they form an electrovalent bond.
In an atom, the number of electrons and the number of protons are equal.	They have more electrons than the number of protons.

4. ***Differentiate between the Covalent & Coordinate Covalent Bond:***

Ans:

Covalent Bond	*Coordinate Covalent Bond*
Both the bonding atoms provide electron(s).	Only one atom provides the electron(s).
It is formed between both similar and dissimilar atoms.	It is formed only between dissimilar atoms.

It is represented by single, double or triple short lines showing the sharing between one, two or three electron pairs.	It is represented by an arrow pointing from the donor to the acceptor atom.
Covalent bond may be polar or non–polar.	Coordinate covalent bond is always polar.
Covalent compounds are usually insoluble in water.	Coordinate covalent compounds are sparingly soluble in water.

5. ***Differentiate between the Metals and Non–metals:***

Ans:

Metals	*Non–metals*
All metals (except mercury) are solids.	Nonmetals are found in all the three physical states: solid, liquid and gas.
Metals are lustrous (shiny).	Nonmetals are non lustrous.
Metals have high melting and boiling points.	Nonmetals have low melting and boiling points.
Metals are usually hard.	Non–metals are usually brittle.
They are good conductors of heat and electricity.	They are poor conductors of heat and electricity.
They are malleable and ductile.	They are not malleable and ductile.
They have high densities.	They have low densities.

Reasons

1. ***Why doesn't Helium atom tend to gain electron?***

Ans: Helium atoms have two electrons and two protons. There is only one shell of electrons, the valence shell of two electrons. It is a noble gas and is thus relatively inert. Since the electrons are as close as can be to the nucleus, in the first energy level, the attractive effect from the nucleus is very strong. Since the valence shell is full, helium does not tend to lose (or to gain) any electrons.

2. ***Why noble gases do not react with other elements to form compounds?***

Ans: Using the Bohr description of electron shells, noble gases have full shells. All of the noble gases have full outer shells. The full valence electron shells make noble gases extremely stable and unlikely to form chemical bonds because they have little tendency to gain or lose electrons. That is why noble gases do not normally react with other elements to form compounds.
The first noble gas is little helium (He), with a shell that is full with only two electrons. The fact that their outer shells are full means they don't need to react with other elements. They rarely combine with other elements. That non-reactivity is why they are called inert. there are some exceptions. Xe may form compounds with fluoride and oxide.

3. ***Why Fluoride ion is not considered a Neon atom?***

Ans: A fluoride ion has the same electronic structure as a neon atom (Ne). However, a fluoride ion is not a neon atom. The nucleus of a fluoride ion is the nucleus of a fluorine atom and has 9 protons - but the nucleus of a neon atom has 10.

4. ***Why coordinate covalent bond is always a polar bond?***

Ans: Covalent bonds may be polar or nonpolar. But, coordinate bonds are always polar because they are formed between two, unlike atoms and only one atom supplied both shared pair electron due to which partial positive charge appears on donor and partial negative charge on the acceptor.

5. *Why does not a hydrogen atom form more than one covalent bond?*

Ans: Hydrogen atoms form only one covalent bond because they have only one valence electron to pair.

6. *Why a dipole does occur in a molecule?*

Ans: Molecular dipoles occur due to the unequal sharing of electrons between atoms in a molecule. Those atoms that are more electronegative pull the bonded electrons closer to themselves. The buildup of electron density around an atom or discreet region of a molecule can result in a molecular dipole in which one side of the molecule possesses a partially negative charge and the other side a partially positive charge. Molecules with dipoles that are not cancelled by their molecular geometry are said to be polar.

7. *Why metals are good conductors of heat and electricity?*

Ans: Metals are conductors of electricity and heat due to the presence of delocalized electrons (mobile electrons).

8. *Explain why table salt has a very high melting point.*

Ans: Sodium Chloride has a high melting point, as it has a giant ionic lattice hence has strong electrostatic forces of attraction between oppositely charged ions, which requires lots of energy to overcome the forces.

9. *Why is to easy for a magnesium atom to lose two electrons?*

Ans: Most elements, except the noble gases in group 8 of the periodic table, are highly unstable and very reactive. The group number to which an element belongs corresponds with how many electrons there are in its outer electron 'shell'. All atoms want to have eight electrons in their outer shell (like the noble gases) to be stable and unreactive. Magnesium is in group 2 of the Periodic Table, so has two electrons in its outer shell. By losing these 2 electrons to become a positive ion will leave it stable and content.

10. *Atoms of metallic elements can form an ionic bond, but they are not very good to form covalent bonds. Why?*

Ans: The crystal lattice of metals consists of ions NOT atoms-surrounded by a 'sea of electrons' forming a giant lattice. These free or 'delocalised' electrons are the 'electronic glue' holding the particles together. There is a strong electrical force of attraction between these mobile electrons (–) and the 'immobile' positive metal ions (+)and this is the metallic bond. That is why atoms of metallic elements can form an ionic bond, but they are not very good to form covalent bonds.

11. *Why Intermolecular forces are weaker than intera-molecular forces?*

Ans: Intermolecular forces are weaker than intramolecular forces. Intramolecular forces in this case include bonding forces within a molecule from ionic and covalent bonds. Intermolecular forces are forces between different molecules and include things like London dispersion forces, Van der Waals forces, and dipole-dipole interactions. Intramolecular forces are stronger because they involve the actual sharing of electrons for covalent bonds. This sharing of electrons gives each element of the bond an octet of electrons in the valence shell which is a highly stable electronic configuration. Ionic bonds involve strong electrostatic interactions between ions. By comparison, intermolecular interactions do not involve the sharing or transfer of electrons and electrostatic interactions like hydrogen bonding only involve partial charges, not fully charged ions.

12. *Covalent bonds are strong and hard to break but why most of the covalent compounds have low melting and boiling points.*

Ans: Covalently bonded molecules have strong bonds within the molecule but intermolecular forces between simple molecules are weak. That is why little energy is needed to break the weak intermolecular forces and covalent compounds have low melting and boiling points.

13. *Why ionic compounds are solids?*

Ans: Ionic compounds are solids and somewhat hard and they have high melting and boiling points because of a strong force of attraction between positive and negative ions.

14. *Ionic bonds are the strongest bonds.*

Ans: Ionic bonds are the strongest bonds because they are formed between the oppositely charged ions which are held together by very strong electrostatic forces.

15. *Ionic compounds can not conduct electricity in the solid state.*

Ans: Ionic compounds can not conduct electricity in the solid state because the ions are not able to move. For the conduction of electricity, ions must be free, so they can conduct electricity only in the molten or aqueous state.

16. *Metals are either soft or hard.*

Ans: ***Metals are soft or hard:*** Metals are either soft or hard because they have different strengths of metallic bonding between them. If the metallic bond is strong, the metal is hard. If the metallic bond is weak, the metal is soft. The strength of metallic bond depends on two factors: the number of positive charges on the metallic ions and the number of electrons set free by the metal.

Section D — Numericals:

Solved Examples of the Textbook

1. *Write the electronic configuration of Ne (atomic no. 10), Carbon (atomic number 6) and Sulphur (atomic number 16).*

Ans:
Electronic Configuration of Ne (atomic no. 10): $1s^2 2s^2 2p^6$
Electronic Configuration of C (atomic no. 6): $1s^2 2s^2 2p^2$
Electronic Configuration of S (atomic no. 16): $1s^2 2s^2 2p^6 3s^2 3p^4$

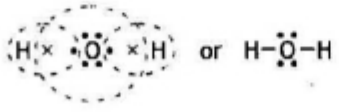
2. *Find the number of valence electrons in the following atoms:*
(a) Chlorine (b) Sodium (c) Magnesium (d) Potassium

Ans:

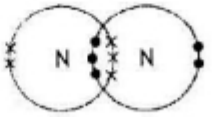
	Element	Atomic Number	Electronic Configuration	No. of valence electrons
(a)	Chlorine	17	$1s^2 2s^2 2p^6 3s^2 3p^5$	7
(b)	Sodium	11	$1s^2 2s^2 2p^6 3s^1$	1
(c)	Magnesium	12	$1s^2 2s^2 2p^6 3s^2$	2
(d)	Potassium	19	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$	1

3. *Draw electron dot and cross structures for the following atoms.*
(a) H_2O (b) N_2 (c) CH_4 (d) C_2H_2 (e) Cl_2 (f) H_2

Ans: (a)

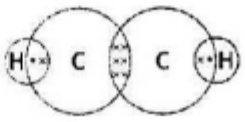


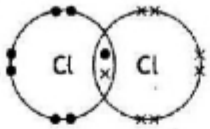
(b)

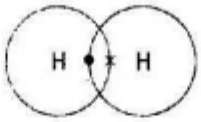


(c)

(d)



(e) 

(f) 

(g) Electronic formula of a hydrogen molecule. H : H

(h) Electronic formula of an oxygen molecule. ⁘Ö⁘ :Ö:

(i) Electronic formula of an acetylene molecule. H × • C ⁝⁝ C • × H

Summary

- Every atom tries to achieve a noble gas configuration.
- Only the outer most valence electrons are involved in bonding.
- Ionic bonding involves the transfer of electrons.
- The metal reacts with the non-metal to form an ionic compound.
- Atoms that lose electron(s) form positive ions. Atoms that gain an electron(s) form a negative ion.
- In an ion, the number of electrons is different from the number of protons.
- Ionic bonding is commonly formed between elements of group IA or IIA and groups VIA or VIIA.
- Covalent bonding involves sharing of electrons and form molecules.
- The sharing of three pairs of electrons between two atoms is called a triple bond.
- Metal tends to lose valence electrons to form positively charged ions (cations).
- Non-metals usually gain electrons to form negatively charged ions (anions).
- Common covalent molecules are water H_2O, Methane CH_4, Ammonia NH_3 and carbon dioxide CO_2.
- A coordinate bond also called a dative covalent bond.
- A covalent bond can be polar or non-polar. But the coordinate bond is only polar in which both electrons come from the same atom.
- The sharing of two pairs of electrons between two atoms is called a double covalent bond.
- A hydrogen bond is a partially electrostatic attraction between hydrogen (H) which is bound to a more electronegative atom such as nitrogen (N), oxygen (O), or fluorine (F), and another adjacent atom bearing a lone pair of electrons.
- When the slightly negative end of a polar molecule is weakly attracted to the slightly positive end of another molecule then such attracting forces are called dipole-dipole interactions.

Solution of Textbook Exercise

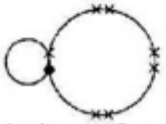
SECTION-A: MULTIPLE CHOICE QUESTIONS

Tick Mark (✓) the correct answer:

See "Multiple Choice Questions (M.C.Qs)" - (1) to (20)

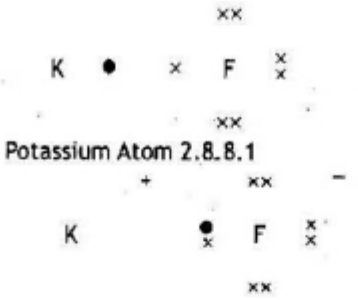
SECTION-B: SHORT QUESTIONS:

1. ***Draw dot and cross diagrams to show how different types of chemical bonds are formed when fluorine reacts with: (a) hydrogen (b) potassium***

Ans: (a) 

hydrogen fluoride

(b)



2. ***What is meant by the octet and duplet rule?***

Ans: See 'Short & Detailed Answer Questions' - Q.3

3. ***Can you draw an ion that is formed by the atom losing three electrons?***

Ans: Aluminum atom is an atom that loses three electrons.
See 'Short & Detailed Answer Questions' - Q.25 (b)

4. ***How oxygen forms an anion?***

Ans: See 'Short & Detailed Answer Questions' - Q.24 (b)

5. ***What is the difference between lone pair and bond pair?***

Ans: See 'Differences' - Q.2

6. ***Explain why table salt has a very high melting point.***

Ans: See 'Reasons' - Q.8

7. ***How is the electronegative value determined the formation of a chemical bond?***

Ans: See 'Short & Detailed Answer Questions' - Q.37

8. ***Why is it easy for a magnesium atom to lose two electrons?***

Ans: See 'Reasons' - Q.9

9. ***Atoms of metallic elements can form an ionic bond, but they are not very good to form covalent bonds. Why?***

Ans: See 'Reasons' - Q.10

10. ***How does anion differ from an atom?***

Ans: See 'Differences' - Q.3

11. ***Describe dipole-dipole forces.***

Ans: See 'Short & Detailed Answer Questions' - Q.38

12. ***Write uses of adhesive material.***

Ans: See 'Short & Detailed Answer Questions' - Q.35

13. ***Why Intermolecular forces are weaker than intera-molecular forces?***

Ans: See 'Reasons' - Q.11

14. ***Write characteristics of metallic bond.***

Ans: See 'Short & Detailed Answer Questions' - Q.20

15. ***Covalent bonds are strong and hard to break but why most of the covalent compounds have low melting and boiling points.***

Ans: See 'Reasons' - Q.12

16. ***Write down the characteristics of ionic compounds.***

Ans: See 'Short & Detailed Answer Questions' - Q.32

17. ***Why ionic compounds are solids?***

Ans: See 'Reasons' - Q.13

18. ***How is hydrogen bonding affecting the physical properties of compounds?***

Ans: See 'Short & Detailed Answer Questions' - Q.39

19. ***Complete the chart:***

Ans:

Atomic Number	Number of protons	Number of electrons	Electronic configuration	Number of valence electrons
11	11	11	2, 8, 1	1
12	12	12	2, 8, 2	2
13	13	13	2, 8, 3	3
14	14	14	2, 8, 4	4
15	15	15	2, 8, 5	5
16	16	16	2, 8, 6	6

SECTION-C: DETAILED QUESTIONS:

1. ***Define ionic bond. Discuss the formation of sodium chloride (NaCl).***

Ans: See 'Short & Detailed Answer Questions' - Q.9 & Q.11 (a)

2. ***Explain element attain stability.***

Ans: An element that does not have two or eight electrons in its valence shell is unstable. It gets stability by losing, gaining or sharing electron to complete the noble gas electronic configuration. Elements attain stability by completing duplet or octet.
See 'Short & Detailed Answer Questions' - Q.3

3. ***Describe the formation of a covalent bond between two non-metallic atoms. Explain single, double and triple covalent bond with examples.***

Ans: See 'Short & Detailed Answer Questions' - Q.12, 15, 16 & 17

4. ***How are electrons arranged in molecular compounds? Draw electron-dot and cross structures for the following atoms.***
(a) H_2O (b) N_2 (c) CH_4 (d) C_2H_2 (e) Cl_2 (f) H_2

Ans: See 'Short & Detailed Answer Questions' - Q.40
See 'Numericals' - Q.3

5. ***Define metallic bond. How are metallic bonds are formed?***

Ans: See 'Short & Detailed Answer Questions' - Q.20

6. ***What is a coordinate covalent bond? Explain with two examples.***

Ans: See 'Short & Detailed Answer Questions' - Q.19

7. ***What do you understand about the ionic character of the covalent bond?***

Ans: See 'Short & Detailed Answer Questions' - Q.41

8. ***Differentiate the properties of polar and non-polar compounds.***

Ans: See 'Differences' - Q.1

9. ***Explain the importance of glues and epoxy resins in our society.***

Ans: See 'Short & Detailed Answer Questions' - Q.35 & Q.36