Explanation

In case of metals, the hold of nucleus over the outermost electrons is weak because of large sized atoms and greater number of shells in between nucleus and valence electrons. Furthermore, because of low ionization potentials, metals have the tendency to lose their outer electrons easily. Resultantly, these loose or free electrons of all metal atoms move freely in the spaces between atoms of a metal. None of these electrons is attached to any particular atom. Either they belong to a common pool, or belong to all the atoms of that metal. Nuclei of metal atoms appear submerged in sea of these free mobile electrons. These mobile electrons are responsible for holding the atoms of metals together forming a metallic bond. A simple metallic bond is shown in figure.

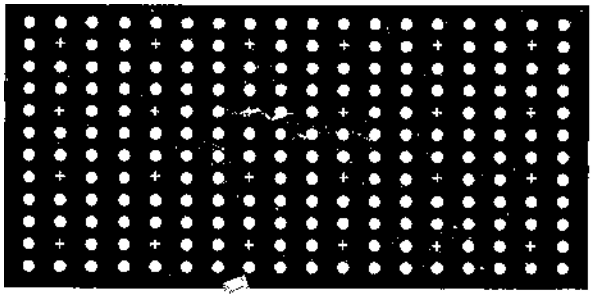


Fig. A schematic diagram of copper wire showing its positive nuclei (+) embedded in sea of free electrons (o) making Metallic bonding

Short Answer Questions

Q.l. Why atoms form a chemical bond?

Ans. Atoms form a chemical bond to achieve stability by acquiring inert gas electron configuration.

Q.2. Why noble gases are non-reactive in nature'?

Ans. The noble gases do have 2 or 8 electrons in their valence shells. It means that all the noble gases have their valence shell completely filled. Their atoms do not have vacant space in their valence shell to accommodate extra electrons. Therefore, noble gases do not gain, lose or share electrons. That is why they are non-reactive, at ordinary conditions. Q.3. How an atom can accommodate eight electrons in its valence shell?

Ans. An atom can accommodate eight electrons in Its valence shell in three ways

i. By giving valence shell electrons (if they are less four) to other atoms ii. By gaining electrons from other atoms (if the valence shell has five or more electrons in it) iii. By sharing valence electrons with other atoms Q.4. When atoms are considered to be unstable?

Ans. The atoms having less than 2 or 8 electrons in their valence shells are unstable.

Q.5. What is the mode of reaction of an atom with reference to their group?

Ans. Mode of reaction of an atom depends upon its number of valence shell electrons. For example, group I has only I electron in its valence shell and group 17 has 7 electrons in its valence shell.

Q.6. What is meant by a chemical bond?

Ans. A force of attraction between atoms that holds them together in a molecule is called a chemical bond.

Q.7. What is meant by duplet rule?

Ans. The attaining of two electrons in the outermost shell by sharing, by losing or by gaining electrons is called duplet rule. Q.8. What is meant by octet rule? Ans. The attaining of eight electrons in the outermost shell by sharing, by losing or by gaining electrons is called octet rule.

Q.9. What would be the effect, when two approaching atoms come closer to each Other?

Ans. When two approaching atoms come closer, the attractive as well as repulsive forces become operative.

Q.IO. What is the effect of attractive and epulsive forces in the formation of a chemical bond?

Ans. If attractive forces become dominate, the decrease in the energy of the system takes place, due to which chemical bond is formed. While, if repulsive forces become dominate, the increase in the energy of the system takes place, due to which no chemical bond is formed.

QA I. What is meant by bonding electrons?

Ans. The valence electrons, which are involved in chemical bonding, are termed as bonding elec ons.

Q.12. Name different types of chemical bonds

Ans.

(i) Ionic bond (ii) Covalent bond

(iii) Co-ordinate covalent bond (i v) Metallic bond

Q.13. Define ionic bond

Ans. The bond formed by the complete transfer of electrons from one atom to another is called ionic bond.

Q.14. What is meant by covalent bond?

Ans. The bond formed by the mutual sharing of pairs of electrons is called covalent bond. Q. 15. What is meant by single covalent bond? Give example.

Ans. When one electron is contributed by each bonded atoms, one bond pair is formed and it forms a single covalent bond. It is represented by (—) . A few examples of molecules with single covalent bonds are hydrogen, chlorine, hydrochloric acid, methane etc.

(2.16. What is meant by double covalent bond? Give example.

Ans. When each bonded atom contributes two electrons, two bond pairs are shared and a double covalent bond is formed. It is represented by A few examples of molecules with double covalent bonds are oxygen, ethene etc.

(2.17. What is meant by triple covalent bond? Give example.

Ans. When each bonded atom contributes three electrons, three bond pairs are involved in bond formation. This type is called triple covalent bond. It is represented by (9. A few examples of molecules with triple covalent bonds arc nitrogen, ethyne etc.

(2.18. What is meant by bond pair?

Ans. The electrons that pair up to form a chemical bond is called bond pair electrons.

(2.19. What is meant by Ione pair?

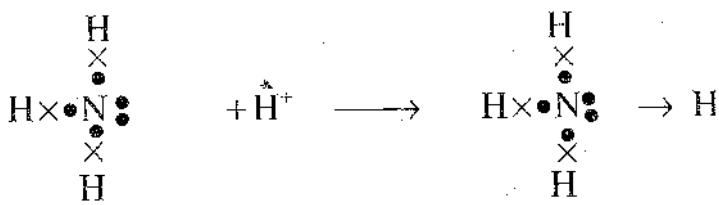
Ans. A non-bonded electron pair available on an atom is termed as Ione pair of electrc,n. Q. 20. Describe Lewis structure diagram.

Ans. The electronic configuration of the valence shells of atoms is shown in small 'dofs' or 'crosses' around the symbol of the element. Each dot or cross represents an electron. Thig is a standard method of Lewis to describe the electronic configuration of valence shell of an atom. It is called Lewis structure diagram.

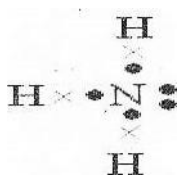
Q.21. Define coordinate **t bond.** covalent bond.

Ans. A type of covalent bond in which the bond pair of electrons is donated by one bonded atom only is called coordinate covalent or d*ive bond. Q.22. How coordinate covalent bond is formed in NH4+?

Ans.



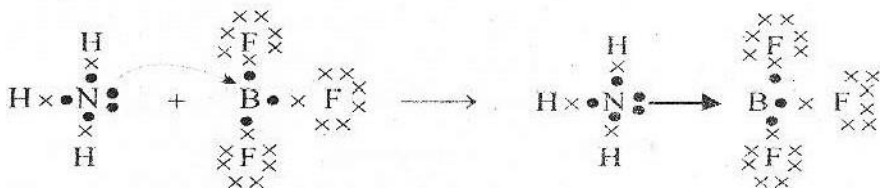
Q.23. Draw Lewis dot structure of ammonia.



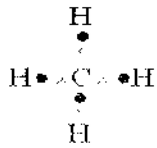
(2.24. Draw Lewis dot structure of nitrogen.

Ans e 

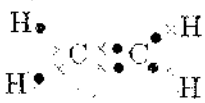
Q.25. How coordinate covalent bond is formed between NH3 and BF3? Ans.



Q.26. Draw Lewis dot structure of methane. Ans.



Q.27. Draw Lewis dot structure of ethane.
Ans.



Q.28. Draw Lewis dot structure of ethyne.
Ans.

H.xcE CoxH

Q.29. What is meant by non-polar covalent bond? Give example.

Ans. If a covalent bond formed between two similar atoms, the shared pair of electrons is attracted by both atoms equally. Such type of bond is called non-polar covalent bond. A few examples of molecules with non-polar covalent bonds arc hydrogen, chlorine, nitrogen etc.

(2.30. What is meant by polar covalent bond? Give example.

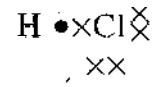
Ans. If a covalent bond formed between two different types of atoms, then the bond pair of electrons will not be attracted equally by the bonded atoms. Such type of bond is called polar covalent bond. A few examples of molecules with polar covalent bonds are hydrochloric acid, water etc.

(2.31. What is meant by electronegative atom?

Ans. The atom will attract the bond pair of electrons more strongly than the other one dunng polar covalent bond formation. This atom will be called as more electronegative atom as compared to the other bonded atom. For example, in HCI molecule CI is more electronegative atom as compared to H atom.

Q.32. Give the formation of polar covalent bond in HCI molecule.

Ans. The difference between electronegativities of hydrogen and chlorine is 1.0. As the electronegativity of chlorine is more, it attracts the shared pair of electron towards itself with a greater force. A partial negative charge is therefore created on chlorine and in turn a partial positive charge on hydrogen due to electronegativity difference. It creates polarity in the bond and is called a polar cövalent bond.



Q.33. What do you mean by delta sign and why it develops?

Ans. The delta (ö) sign indicates partial positive or partial negative charge that IS developed due to unequal sharing pair or bonded pairof electrons,

Q.34. What is the effect of electronegativity in the formation of an ionic bond?

Ans. By using electronegativity values, it is possible to predict whether a chemical bond will be ionic or a covalent in nature. A bond fornvd between elements of high electronegativity (halogen group) and elements of low electronegativity (alkali metals) are ionic in nature.

Q.35. How electronegativity values help us to predict the formation of a chemical bond? Ans. If the difference of electronegativities between two elements is more than 1.7 the bond between them will be predominately ionic bond and if it is less than I .7, the bond between two atoms will be predominately covalent.

Q.36. What is meant by metallic bond?

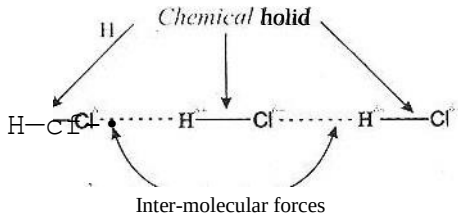
Ans. A bond formed between metal atoms (positively charged ions) due to mobile or free electrons is called metallic bond.

Q.37. What is meant by intermolecular forces?

Ans. A weak force of attractions formed between two molecules is called intermolecular forces

Q.38. Show the bonding and intermolecular forces in HCI molecule.

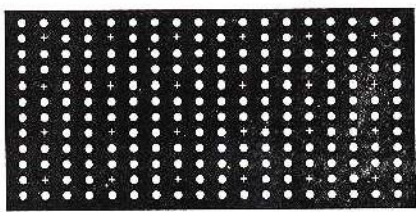
Ans.



Q.39. What is meant by Van der Waals forces?

Ans. All intermolecular forces, which are collectively called Van der Waals forces, are electrical in nature. They result from the attractions of opposite charges which may be temporary or permanent.

Q.40. Draw a schematic diagram of copper wire showing metallic bonding.

Ans. 

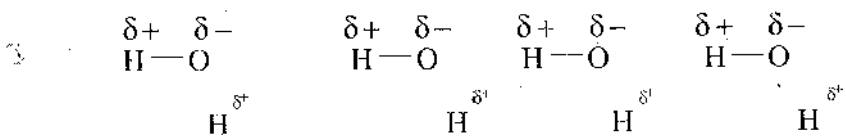
Q.41. How dipole-dipole interactions are found in I-ICI molecule?

Ans. When partial positive and partial negative charges exist at different positions in molecule, the adjacent molecules will arrange themselves in such a way that negative portion of that molecule come near to positive portion of other molecule. It results in net forces of attraction between oppositely charged portions of two adjacent molecules. These attractive forces are called dipole-dipole interactions as represented in HCI

Q.42. What is meant by hydrogen bonding?

Ans. A bond formed between partially positive hydrogen atom of one molecule with partially negative atom of the other molecule is called hydrogen bonding. Q.43. Draw a structure of water molecules showing hydrogen bonding.

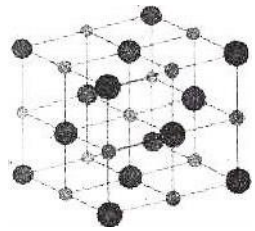
Ansž



Q.44. Why ice floats on the surface of water? Ans. At $O^{O}C$ ice has a lesser density (0.0917 g/cm^3), than water (O. 100 g/cm^3), due to which ice floats on the surface of water.

Q.45.Describe the regular arrangement of Na+ and Cl- ions in solid crystal of MCI.

Ans.



Q.46. What are ionic compounds? Give example.

Ans. Those compounds which contain ionic bond in them are known as ionic compounds. e.g. , NaCl, KCI etc.

Q.47. Write any two properties of ionic compounds.

Ans. (i) They are made up of positively and negatively charged ions. (ii) They are consist of ions not the molecules.

Q.48. Ionic solids are good conductors of electricity. Why?

Ans. ionic solids arc good conductors of electricity only in solution and in the molten form due to the presence of free ions in them.

(2.49. When covalent compounds are considered to be a good conductor of electricity? Ans. They are considered to be good conductors of electricity due to having polar character in their bonding when they are dissolve in polar solutions.

Q.50. Why coordinate covalent compounds do not form ions in water?

Ans. They do not form ions in water because the nuclei in these compounds are held shared electrons.

(2.51. What is meant by malleability and ductility?

Ans. Malleability is the property by virtue of which a metal can be drawn into sheets, while ductility is the property by vicae of which a metal can be drawn into wires. Q.52. Name polymers or resins used in synthetic adhesives. Ans. i. Thermoplastics ii. Thermosets

Q.53. Give composition of epoxy.

Ans. Epoxy is polymer that is formed from two different chemicals

1. Resin_____ ii. Hardener

(2.54. Give uses of adhesives.

Ans. These highly performance adhesives arc used in the construction of

i, Aircrafts ii. Automobiles iii. Bicycles iv. Boats v. Golf clubs etc

(2.55. What are the applications of epoxy adhesives?

Ans. They can be made flexible or rigid, transparent or opaque, colored as well as fast or slow setting.

Q.56. What properties show presence of different types of chemical bond between atoms of metals?

Ans. The different propeltics shown by metals such as high melting and boiling points, good conductions of heat and electricity, hard and heavy nature, suggest existence of different type of chemical bond between atoms of metals, Q.57. How metallic bond is formed?

Ans. In metals, the• hold of nucleus over the outermost electrons is weak because of large sized atoms and greater number of shells in between nucleus and valance electrons. Because ot low ionization potentials, metals have the tendency to lose their outer electrons easily. Due to which, these loose or free electrons of all metal atoms move freely in the spaces between atoms

of a metal. The nuclei of metal atoms appear submerged in sea of free mobile electrons. These mobile electrons are responsible for holditl" the atoms of metals together forming a rnetallic bond.

Polar compounds	Non-polar compounds
They are soluble in water il.	They in water are soluble in non-polar solvents benzene, petrol etc do not conduct electricity
They arc insoluble in non-polt'o solvents like benzene, petrol etc	They like
They can conduct electricity in the form of aqueous solution	'i, They
v. Examples are: HCI, I-IF	v. Examples are: CH4, C'H2

(2.58. Differentiate between polar and non-polar compounds

Ans.

Q.59. Whv does sodium torm a chemical bond with chlorine?

Ans. Sodium forms a chemical bond with chlorine due to the following reasons

i) Sodium has the tendency to lose one electron and chlorine has the tendency to gain one electron. This favors the transference of electrons and hence ionic bond is formed.

ii) Sodium is electropositive and is •at high energy state whereas chlorine is electronegative and is at low energy state. This energy diffCrence favors the formation of ionic bond between them.

œ6(). Why sodium does lose an electron and attains +1 charge?

Ans. Sodium has the electronic configuration as follows

$_{11}Na = 1s^2, 2s^2, 2p^6, 3s^1$

Hence, it is better and easier for sodium to lose one electron and complete its valence shell rather than gaining seven electrons to complete the octet. Q.61. How do atoms follow octet rule?

Ans. Most of the atoms or elements in the periodic table gain stability by having eight electrons in their valence shell. They do so it by gaining, sharing or losing elecžrons. This is how they follow octet rule. They attain the electronic configuration of nearest noble gas (2.62. Which electrons are involved in chemical bonding?

Ans. Only the electrons present in the valence shell of an atom are involved in chemical bonding. All the other electrons do not take part in chemical bonding

(2.63. Why does group 1 elements prefer to combine with group 17 elements?

Ans. Group I elements are good losers of electrons and have low ionization energies. Group 17 elements are good gainers of electrons and have high electron affinities. Therefore, as

these parameters favor the formation of bond between the two a strong ionic bond is formed between group I and group 17 elements

Q.64. Why chlorine can accept only one electron?

Ans. The electronic configuration of chlorine is

$_{17}Cl = 1s^2, 2s^2, 2p^6, 3s^2, 3p^5$

It can gain a maximum of one electron because it follows octet rule and can have a maximum of eight electrons in its valence shell.

(2.65. Give the electronic configuration of carbon atom

Ans. $6C = Is^2, 2s^2, 2P2$

Q.66. What type of elements have tendency of sharing of electrons?

Ans. The elements with electronegativity values less than 1.7 show tendency of sharing electrons between them.

Q.67. If repulsive forces dominate to attractive forces, will a covalent bond form?

Ans. When the repulsive forces dominate the attractive forces, a bond will not be formed. This is due to the fact that repulsive forces account for increase in energy. Bond is formerd when the atoms are at a state of minimum energy. As repulsive force will increase energy, so a covalent bond will not be formed.

Q.68. Considering the electronic configuration of nitrogen atom, how many electrons are involved in bond formation and what type of covalent bond is formed? Ans. The electronic configuration of nitrogen is

$_7N = 1s^2, 2s^2, 2p^3$

The valence shell of nitrogen is deficient of three electrons. These two nitrogen atoms share their three valence electrons each to form a triple covalent bond with three pairs of electrons and six electrons as a total shared.

Q.69. Point out the type of covalent bonds in the following molecules

CH4, C2H4, H2, N2 and 02 Ans.

i) CH4 Single covalent bond ii) C2H4 Double covalent bond iii) H2 Single covalent bond iv) N2 Triple covalent bond

v) 02 Double covalent bond

(2.70. What is lone pair? How many lone pairs of electrons are present in nitrogen and ammonia?

Ans. The pair of electrons in the valence shell of an atom which does not take part in chemical bonding is called lone pair electrons.

In nitrogen there are two lone pairs and on each -atom a Ione pair is present. In ammonia, there is only one lone pair present on nitrogen atom while hydrogen does not have any lone pair.

Q.71. Why is the BF3 electron deficient?

Ans. Boron has the electronic configuration as $Is^2\ 2s^2\ 2p^1$. This means that it needs five more electrons to be stabilized. In BF3 if shares three electrons, each with one fluorine atom and thus attains six electrons in its valence shell. It still retains the tendency to gain two more electrons and therefore remains electron deficient.

Q.72. What types of electron pairs make a molecule good donor?

Ans. Lone pair of electrons makes a molecule a good donor. Since, they are not involved 111 bonding, so they can be used o form türther bonds e.g. ,ln ammonia, there is one Ione pair on nitrogen which forms a coordinate covalent bond with another hydrogen forming ammonium Ion.

(2.73. What is the difference between bonded and lone pair of electron and how many bonded pair of electrons is present in NH3 molecule?

Ans. Valence shell electron pair involved in chemical bonding is a bond pair and one not involved is the lone pair of electrons and can form further bonds in certain cases. Three pairs of bonded electrons are present in NH3 as there are three single covalent bonds in ammonia molecule between one nitrogen and three hydrogen atoms.

Q.74. Why does oxygen molecule not form a polar covalent bond? —

Ans. In oxygen molecule (02) two oxygen ato are covalently bonded to each other. As the atoms are similar, the electronegativity difference is zero, and the electron pairs are equally shared between them. Hence, there is no polarity in the bond. Q.75. Why water molecule form a polar covalent bând?

Ans. Oxygen is a highly electronegative atom as compared to hydrogen. So, during the mutual shanng, the electron pair is attracted more towards oxygen and it acquires a partial negative charge and a partial positive charge develops on hydrogen. Hence, poles are created and-she covalent bond becomes polar.

Q.76. What type of elements form metallic bonds?

Ans. Metallic bonds consist of sea of mobile electrons with positive ions. They are present in elements which have loosely bound electrons that do not remain in the valence shell and leave the atom to form a sea of electrons. Such a structure is observed usually in metals e.g., sodium, iron in metals.

Q.77.Why in metals the hold of nucleus over the outermost electrons is weak? Give reason.

Ans. The hold of nucleus on the outermost electrons in metals is very weak because Of the increased screening effect or shieldintr effect between the intervening electrons which tend to decrease the force of attraction between nucleus and the electrons. Distance also plays the same role. As the electrons arc at a greater distance from nucleus, the force of attraction becomes weak.

Q78. Why the electrons move freely in metals?

Ans. Because, the hold of nucleus over the outermost electrons is weak because of large sized atoms and greater number of shells in between nucleus and valence electrons. Furthermore, because of low ionization potentials, metals have the tendency to lose their outer electrons easily. Resultantly, these loose or free electrons of all metal atoms move freely in free space between atoms of a metal.

Q79. Which types of electrons are responsible for holdings the atom together in metals? Ans. The mobile electrons are responsible for holding the atoms of metals together forming a metallic bond.

Q80. Why a dipole develops in a molecule?

Ans. The unequal sharing of electrons between two different types of atoms make one end of molecule slightly positive and other cnd slightly negatively charged. Hence a dipole develops in a molecule.

(281. What do you mean by dipole induced forces?

Ans. The positive end of polar molecule attracts the mobile electrons of the nearby ncn -polar molecule. In this way polarity is introduced in non-polar molecule and both become dipoles. These forces are called dipole indNcecI forces.

Q82. Why dipole forces of attraction are not found in halogen molecules?

Ans. Halogen molecules form a non-polar covalent bond between them. In order to make non-polar bonds, no electronegative differer:ee of elements is required, due to which dipole forces do not formed in halogen molecules.

Q83. What types of attraction forces exist between HCI molecules?

Ans. Weak intermolecular forces exist between HCI molecules.

Q84. Why ionic compounds have high melting and boiling points?

Ans. As ionic compounds are made up of positive and negative ions, there exist strong electrostatic forces of attraction between oppositely charged ions. So, a great amount of energy is required to break these forces, therefore ionic compounds have high melting and boiling points.

(285. Why ionic compounds are easily soluble in water?

Ans. Water has high dielectric constant that weakens the attraction between the ions of ionic compounds due to which they are easily soluble in water

Q86. What type of attractive forces exists in ionic compounds?

Ans. Ionic bond exists in ionic compounds.

Q87. Why the covalent compounds of bigger size molecules have high melting points? Ans. Bigger molecules with three dimensional bonding forms covalent crystals which are very stable and hard due to which they have high melting and boiling points.

(b)

(c)

(288. How much there is electronegativity difference between the following pair of elements (atoms)? Predict the nature of the bond between them

a) Hand b) H and Na c) Na and 1 d) K and Cl

Ans.

a) H and Cl

Covalent bond 1-1=2.2 Cl=3.2

Di fference=2.1-0.9= 1.2

b) H and Na

Ionic bond F-1=2.1 Na-=0.9

Difference = 2.5-0.9=1.6

c) Na and I

Ionic bond Na=O.9 2.5

Difference = 3 .2-0.8=2.4

d) K and Cl

Ionic bond K=O.8 Cl=3.2

Difference -3.2-2.2= — 1.0

MultipleChoiceQuestions

1. Which of the following is a building block of matter?

(a) Atom (b) Molecule

(b) Element (d) Compound

2. The forces responsible for binding the atoms together in a molecule are called

(a) Hydrogen bond

(b) Ionic bond (c) Chemical bond

(d) Covalent bond

3. Atoms achieve stability by attaining electronic configuration of

(a) Alkali metals

(b) Inert gases

(c) Alkaline earth metals

(d) Coinage metals

4. Attaining two electrons in the valence shell is called

(a) Duplet rule (b) Triplet rule

(c) Octet rule (d) All of them

5. All the noble gases have their valence

(a) Pmtially filled

(b) Completely filled

(c) Less than 2

(d) More than 2 6. Noble gases are non-reactive, because they do not

(a) Gain electrons

(b) Lose electrons

(c) Share electrons

(d) All of them

7. Every atom has a natural tendency to achieve electrons in its valence shell