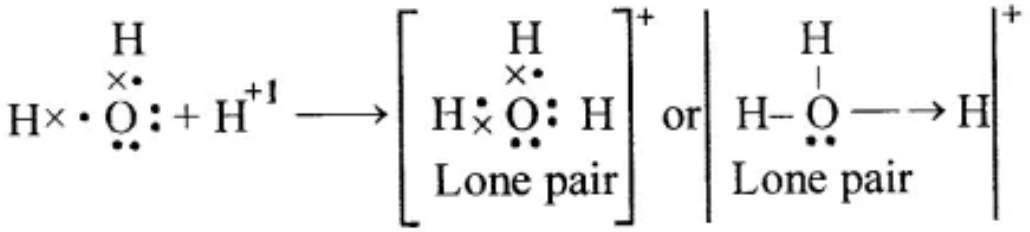
Chemical Bonding

QUESTIONS
2006

Question 1.
What is a lone pair of electrons. Draw an electron dot diagram of a hydronium ion (with lone pair).
Answer:
Lone pair of electrons is the unshared pair of electrons left on the atom in a covalent molecule



Question 2.
Choose the property which is characteristic of an electrovalent compound:
(A) it is easily vaporized
(B) it has a high melting point
(C) it is a weak electrolyte
(D) it often exists as a liquid

Question 3.
State each as oxidation or reduction
(1) $O + 2e \rightarrow O^{2-}$
(2) $K - e \rightarrow K^{+}$
(3) $Fe^{3+} + e^{-} \rightarrow Fe^{2+}$
Answer:

1. Reduction
2. Oxidation
3. Reduction

2007

Question 1.
Name the charged particles which attract one another to form electrovalent compounds.
Answer:
Ions — cations and anions are oppositely charged particles, which attract one another to form an electrovalent bond.

Question 2.
How are electrons involved in the formation of a covalent compound.
Answer:
Covalent bond is formed by sharing of electrons.

Question 3.
The electronic configuration of nitrogen is 2,5. How many electrons in the outer shell of a nitrogen atom are not involved in the formation of a nitrogen molecule.
Answer:
2 electrons in the outer shell of each nitrogen atom are not involved in sharing during formation of nitrogen molecule.

Question 4.
In the formation of magnesium chloride (by direct combination between magnesium and chlorine), name the substance that is oxidized and the substance that is reduced.
Answer:
Mg-oxidized Cl-reduced.

2008

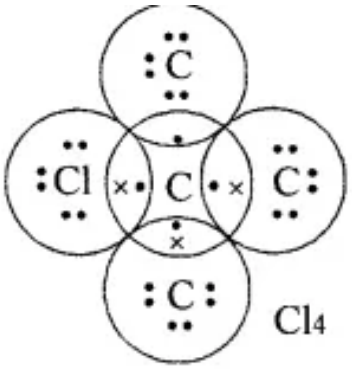
Question 1.
State which is not a common characteristic of an electrovalent compound?
(A) High melting point.
(B) Conducts electricity when molten.
(C) Consists of oppositely charged ions.
(D) Ionizes when dissolved in water.

Question 2.
State the terms defined in each case:
A bond formed by –
(a) a shared pair of electrons, each bonding atom contributing one electron to the pair.
(b) a shared pair of electrons with both electrons coming from the same atom.
Answer:
(a) Covalent bond
(b) Coordinate bond

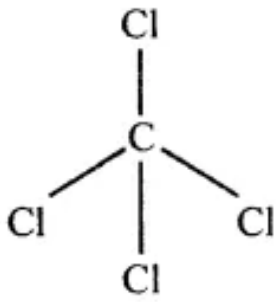
2009

Question 1.
The one which is composed of all the three kinds of bond (ionic; covalent and coordinate bond) is:
(A)Sodium chloride
(B) Ammonia
(C) Carbon tetrachloride
(D) Ammonium chloride

Question 2.
Draw the structural formula of carbon tetrachloride and state the type of bond present in it
Answer:



It has four (C – Cl) covalent bonds



Type of bonds present in carbon tetrachloride is covalent.

2010

Question 1.
Select the correct answer from A, B, C and D – Metals lose electrons during ionization – this change can be called:
(A) Oxidation
(B) Reduction
(C) Redox
(D) Displacement

Question 2.
Select the right answer from the choice -covalent bond / ionic bond / covalent & coordinate bond for each of the following –

1. Sodium chloride
   Ans. Ionic bond.
2. Ammonium ion
   Ans. Covalent and coordinate bond
3. Carbon tetrachloride
   Ans. Covalent bond

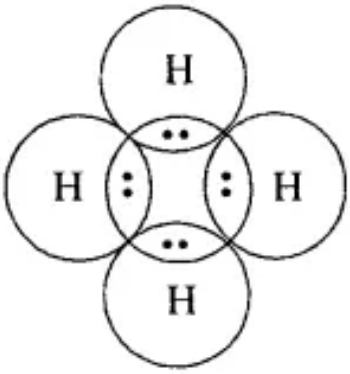
2011

Question 1.

1. In covalent compounds, the bond is formed due to (sharing/transfer) of electrons.
   Ans: sharing
2. Electrovalent compounds have a……. (low/high) boiling point.
   Ans: high
3. A molecule of…….. contains a triple bond, (hydrogen,ammonia,nitrogen)
   Ans: nitrogen

Question 2.
Draw an electron dot diagram, showing the lone pair effect for formation of – NH_4^+ ion from NH^3 gas and H^{1+}

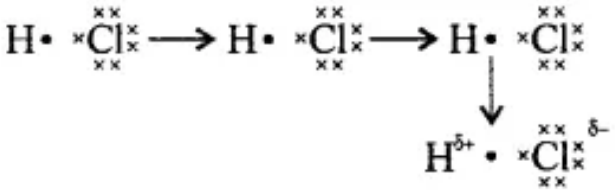
Answer:
$H \rightarrow H^+ + le–$
1 Proton 1 Proton
1 Electron 0 Electron



Ammonia has one lone pair of electrons which is donated to hydrogen atom forming a co-ordinate bond. The arrow represents a co-ordinate bond. The arrow points from the donor to the receptor atom.

Question 3.
Give reasons – Hydrogen chloride can be termed as a polar covalent compound.

Answer:

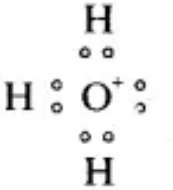


Pure covalent bond exists between two elements which have similar electronegativities. In hydrogen chloride, chlorine being more electronegative attracts the shared pair of electrons towards itself as a result hydrogen acquires partial positive charge and chlorine gets partial negative charge. Thus, hydrogen chloride can be termed as a polar covalent compound.

2012

Question 1.
Draw an electron dot diagram to show the structure of hydronium ion. State the type of bonding present in it.

Answer:



It has coordinate (dative covalent) bonding

Question 2.
There are three elements E, F, G with atomic numbers 19, 8 and 17 respectively. Give the molecular formula of the compound formed between E and G and state the type of chemical bond in this compound.
Answer:
Chemical formula EG, Chemical bond is ionic bond.

2013

Question 1.
A chemical term for. A bond formed by a shared pair of electrons with both electrons coming from the same atom.
Answer:
Coordinate bond

Question 2.
Among the compounds identify the compound that has all three bonds (ionic, covalent and coordinate bond).
(A) Ammonia
(B) Ammonium chloride
(C) Sodium hydroxide
(D) Calcium chloride
Ans.
(B) Ammonium chloride has all the three electronic bonds

Question 3.
State which is not a typical property of an ionic compound?
(A) High melting point
(B) Conducts electricity in molten and in the aqueous solution state
(C) Are insoluble in water
(D) Exist as oppositely charged ions even in the solid state.
Answer:
(C) Ionic compounds are generally insoluble in water

Question 4.
Compare carbon tetrachloride and sodium chloride with regard to solubility in water and electrical conductivity.
Answer:
Carbon tetrachloride is insoluble in water and is not conducting in nature.Sodium chloride is soluble in water and is conducting in nature in aqueous state or molten state.

2014

Question 1.
Compound 'X' consists of only molecules. 'X' will have –
(A) A Crystalline hard structure
(B) A low (m.p.) melting point and low (b.p.) boiling point

(C) An ionic bond
(D) A strong force of attraction between its molecules.

Question 2.
The molecule which contains a triple covalent bond is:
(A) ammonia
(B) methane
(C) water
(D) nitrogen

Question 3.
Give word/phrase for: Formation of ions from molecules.
Answer:
Formation of ions from molecules →Ionisation.

Question 4.
Give a reason why covalent compounds exist as gases, liquids or soft solids?
Answer:
As they have weak force of attraction between their molecules.

2015

Question 1.
Bonding in A: CCl_4 B: H_2; C:HCl; D:NH,CI – involves coordinate bonding.
Answer:
D: NH_4Cl (Ammonium chloride). The bond formed between the nitrogen atom in ammonia and the chloride ion is a coordinate bond.

Question 2.
Give scientific reasons: Carbon tetrachloride does not conduct electricity.
Answer:
Carbon tetrachloride is made of individual covalently bonded molecules, CCl_4. In addition, the charged particles (ions) are absent in CCl_4 which could conduct electricity. So, CCl_4 does not conduct electricity.

Question 3.
Explain the bonding in methane molecule using electron dot structure.
Answer:
Formation of methane molecule – Non-polar covalent compound:

Atom	Electronic configuration	Nearest noble gas	To attain stable electronic configuration of nearest noble gas
Carbon	$^{12}_{6}C$ [2,4]	Neon [2,8]	Carbon needs four electrons to complete the octet
Hydrogen	$^{1}_{1}H$ [1]	Helium [2]	Hydrogen needs one electron to complete the duplet

One atom of carbon shares four electron pairs, one with each of the four atoms of hydrogen.

Question 4.
An element L consists of molecules.
1. What type of bonding is present in the particles that make up L?
2. When L is heated with iron metal, it forms a compound FeL. What chemical term would you use to describe the change undergone by L?

Answer:

1. Covalent bonding is observed in atoms which are similar.
   Hence, covalent bonding is present in the particles which make up element L.
2. When L is heated with iron metal, it forms a compound FeL.
   Here, oxidation of Fe and reduction of L occur as follows:
   $Fe \rightarrow Fe^{2+} + 2e-$ (Direct combination or synthesis)

2016

1. Fill in the blanks with the choices given in brackets.
Question 1.

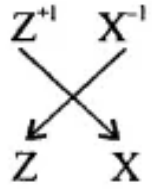
1. Electrovalent compounds have **high** melting points.

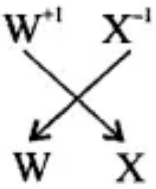
Question 2.
Elements W, X, Y, Z have electronic configurations W = 2, 8, 1 ; X = 2, 8, 7 ; Y = 2, 5 ; Z = 1
(1) What type of bond is formed between:
(a) W and X
(b) Y andZ

(2) What is the formula of the compound formed between
(a) XandZ
(b) W and X

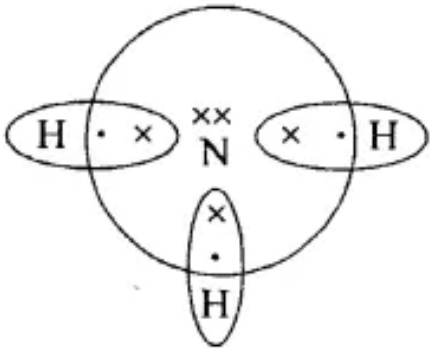
Answer:
(1)

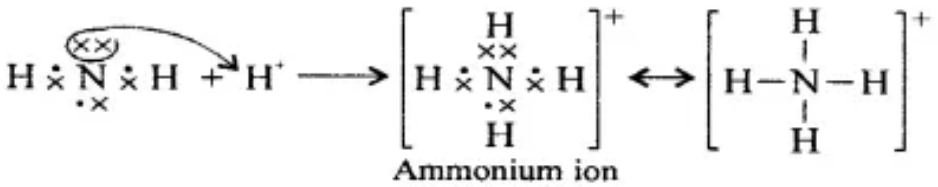
electrovalent
covalent
(2)

1. 

2. 

Question 3.
Draw an electron dot diagram to show the formation of ammonium ion [Atomic No. : N = 7 and H = 1]
Answer:
N(7) → 2, 5 H(l) → 1





2017

1. Fill in the blanks from the choices in brackets –
Question 1.

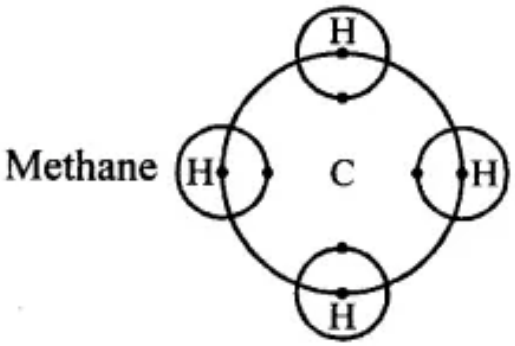
The compound that does not have a lone pair of electrons is **carbon tetrachloride.**

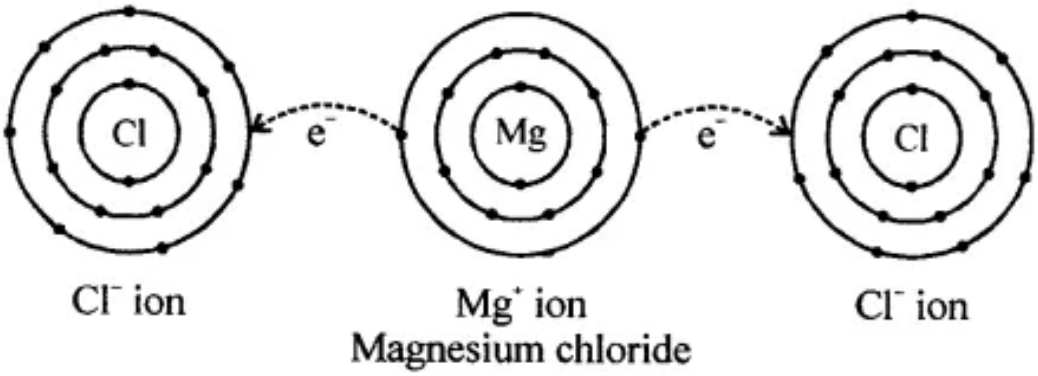
Question 2.
Choose the correct answer – Which of the following is a common characteristic of a covalent compound.
(A) High melting point
(B) Consists of molecules
(C) Always soluble in water
(D) Conducts electricity when it is in the molten state.

Question 3.
State the type of bonding in the following molecules –

(1) Water ; (2) Calcium oxide
Answer:
(1)Water → covalent bond.
(2) Calcium oxide → ionic bond or electrovalent bond.

Question 4.
Draw an electron dot diagram to show the formation of each of the following compounds –
(1) Methane (2) Magnesium chloride
[H = 1, C = 6, Mg = 12, Cl = 17]
Answer:





Additional Questions

Question 1.
State the force which holds two or more atoms together as a stable molecule.
Answer:
Chemical bond.

Question 2.
Draw the geometrical atomic structure representing the electronic configuration of atoms of elements of
(a) Period-2

1. group 14 (IV A)- carbon (at no. 6)
2. group 15 (VA) – nitrogen (at. no. 7)
3. group 16 (VI A) – oxygen (at no. 8)

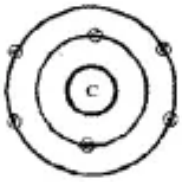
(b) Period-3

1. group 1(IA) – sodium (at no. 11)
2. group 2(HA) – magnesium (at. no. 12)
3. group 17(VDLA) – chlorine (at. no. 17)

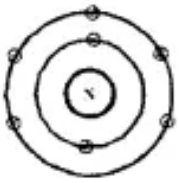
(c) Period -4

1. group 2(ELA) – calcium (at. no. 20).

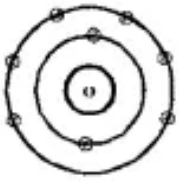
Answer:
(a)

(i) 

Carbon
12
p = 6, n = 6
Elec. conf. 2, 4

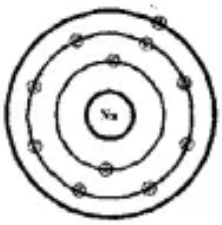
(ii) 

Nitrogen
14
p = 7, n = 7
Elec. conf. 2, 5

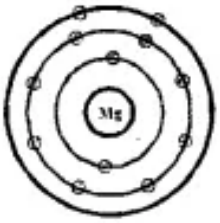
(iii) 

Oxygen
16
p = 8, n = 8
Elec. conf. 2, 6

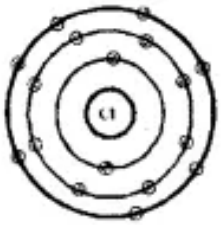
(c)

(b) (i) 

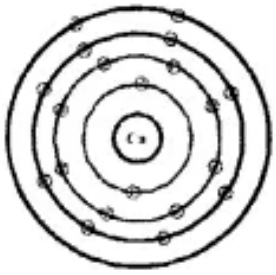
Sodium
23
p = 11, n = 12
Elec. conf. 2, 8, 1

(ii) 

Magnesium
24
p = 12, n = 12
Elec. conf. 2, 8, 2

(iii) 

Chlorine
35, 5
p = 17, n = 18
Elec. conf. 2, 8, 7

(c) 

Calcium
40
p = 20, n = 20
Elec. conf. 2, 8, 8, 2

Question 3.
What is meant by the term 'chemical bond' and 'chemical bonding'.
Answer:
Chemical bond:
The linkage or force which acts between two or more atoms to hold them

together as a stable molecule is called a chemical bond.

Chemical bonding:

The concept of chemical bond is called chemical bonding.

Question 4.

State why noble gases are unreactive while atoms of elements other than noble gases are chemically reactive.

Answer:

Because they have stable electronic configuration that is their outermost shell is complete.

Question 5.

State the reasons for chemical bonding between two atoms and the methods involved for achieving the same. State how 'duplet and octet' rules are involved for an atom to achieve stable electronic config.

Answer:

The driving force for atoms to combine is related to the tendency of each atom to attain stable electronic configuration of nearest noble gas. For an atom to achieve stable electronic configuration it must have;Either two electrons in its outermost shell (if it is the first shell- nearest noble gas – He) – Duplet rule.

OR

Eight electrons in its outermost shell (if it is not the first shell – all noble gases other than He have eight electrons in their outermost shell) – Octet rule.

Methods for achieving chemical bonding

A stable electronic configuration for two combining atoms, resulting in chemical bonding between them is achieved by following two ways.

1. **Electron transfer:** This involves transference of valence electrons from one atom (metal) to another (non-metal) leading to the formation of electrovalent or ionic bond. This results in the formation of electrovalent or ionic compound.
2. **Electron sharing:** This involves sharing of pairs of electrons between two atoms (both non-metals). This leads to the formation of covalent bond. The compound so formed is called a covalent compound.

Question 6.

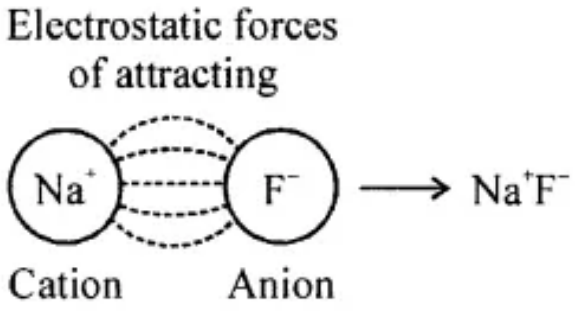
State the type of compounds formed by transfer of valence electrons from one atom to another, and explain the method of formation of the same. State the role of 'cations' and 'anions' in their formation.

Answer:

The type of compounds formed by transfer of valence electrons from one atom to another is ionic or Electrovalent compounds. The atom which loses electron is generally a metallic atom while the atom which gain electrons is generally a non-metallic atom.

The metallic atom loses electrons to attain stable electronic configuration and

becomes a cation. For example,



The non-metallic atom gains electron to attain stable electronic configuration and becomes an anion. For example,
Na Na
The cations and anions so formed are oppositely charged ions, which attract one another to from an electrovalent or ionic bond. This results in the formation of electrovalent or ionic compound (NaF).
……
The bond formation is due to the electrostatic forces of attraction between two oppositely charged ions.

Question 7.
Define the terms:

1. Electrovalent or ionic bond
2. Electrovalent or ionic compound.

Answer:

1. **Electrovalent or ionic bond:** The chemical bond formed between two atoms by transfer of one or more electrons from the atom.
2. **Electrovalent or ionic compound:** The chemical compound formed as a result of transfer of one or more electrons from atom.

Question 8.
What is meant by the term 'electrovalency'. State why Na (at. no. 11) has a electropositive valency of +1 and Cl (at. no. 17) an electronegative valency of -1.
Answer:
Electrovalency: The number of electrons donated or accepted by the valence shell of an atom of an element so as to achieve . the stable electronic configuration is called electrovalency, stable configuration of nearest noble gas i.e., Ne (Z = 10)
……
$Na \rightarrow Na^{+} + e$
(2,8,1) (2,8)

As sodium (Z = 11) loses one electron to achieve it has an electrovalency of + 1

$Cl + e^{-} \rightarrow Cl^{-}$
(2,8,7) (2,8,8)

As chlorine (Z = 17) gains one electron to achieve stable configuration of nearest noble gas i.e., Ar (Z = 18) it has an electrovalency of – 1.

Question 9.
State three differences between 'X' and 'X^{1+}' i.e. an atom and an ion.
Answer:
Atoms – 'X'

1. Electrically – neutral particles
2. May or may not exist – independently
3. Outermost shell – may or may not have duplet or octet.

Ions – X^{1+}

1. Electrically-charged particles [cations, anions]
2. Exist – independently in solution
3. Outermost shell -have complete duplet or octet.

Question 10.
Explain the terms 'oxidation' and reduction' with reference to an atom or ion.
Answer:
oxidation: Loss of one or more electrons by an atom or ion is called oxidation. For example,

$Na \rightarrow Na^{+} + e–$
$Fe^{2+} \rightarrow Fe^{3+} + e\text{-}$
$Mg \rightarrow Mg^{2+} + e\text{-}$

Reduction: Gain of one or more electrons by an atom or ion is called reduction. For example,

$F + e^{-} \rightarrow F^{-}$
$O + 2e\text{-} \rightarrow O^{2}–$
$Cu^{2+} + e^{-} \rightarrow Cu^{+}$
$Zn^{2} + 2e^{-} \rightarrow Zn$

Question 11.
State which of the following are oxidation reactions and which are reduction reactions.
(a)

1. $Cu \rightarrow Cu^{2+} + 2e^{-}$
2. $Cu^{2+} + 2e^{-} \rightarrow Cu$
3. $Sn^{4+} + 2e^{-} \rightarrow Sn^{2+}$
4. $2Cl\text{-} \rightarrow Cl_2 + 2e\text{-}$
5. $Fe^{2+} \rightarrow Fe^{3+} + le^{-}$
6. $X + 2e^{-} \rightarrow X^{2-}$

7. $Y\text{-}Ie^- \rightarrow Y^{1+}$
8. $Z^{3+} + Ie^- \rightarrow Z^{2+}$

Answer:
Oxidation reactions:
(3) $Sn^{4+} + 2e^- \rightarrow Sn^{2+}$
(6) $X + 2e^- \rightarrow X^{2-}$
(7) $Y\text{-}Ie^- \rightarrow Y^{1+}$
(8) $Z^{3+} + Ie^- \rightarrow Z^{2+}$

Reduction reactions.
(1) $Cu \rightarrow Cu^{2+} + 2e^-$
(2) $Cu^{2+} + 2e^- \rightarrow Cu$
(4) $2Cl\text{-} \rightarrow Cl_2 + 2e\text{-}$
(5) $Fe^{2+} \rightarrow Fe^{3+} + Ie^-$

(b)

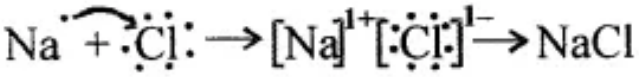
1. $Zn \rightarrow Zn^{2+}$
2. $S \rightarrow S^{2-}$
3. $Sn^{2+} \rightarrow Sn$
4. $Fe^{2+} \rightarrow Fe^{3+}$

Answer:
(1) Oxidation (2) Reduction (3) Reduction (4) Oxidation

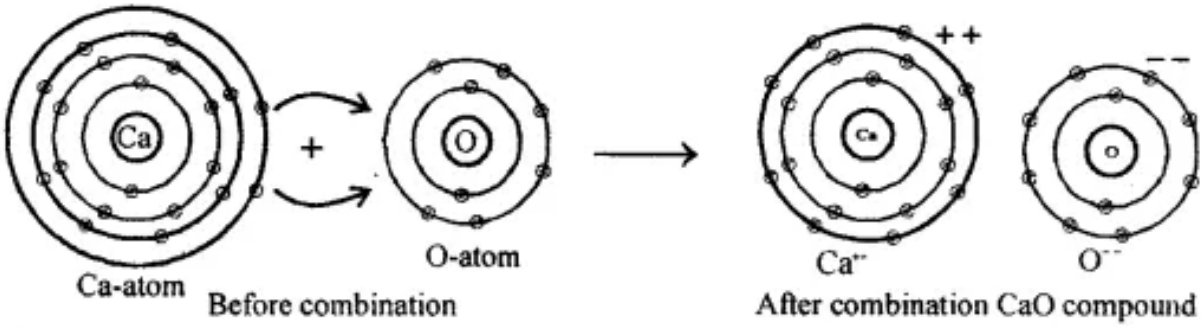
Question 12.
Explain with the help of

(1) An ionic equation
(2) Electron dot structural diagram
(3) Atomic or orbital structural diagram the formation of the following.
(a) Sodium chloride
(b) Calcium oxide
(c) Magnesium chloride.
(at. nos. Na = 11, Cl = 17, Ca = 20, O = 8, Mg = 12)
Answer:
(a) Formation of Sodium Chloride

(1) Ionic equation
……
(2) Electron dot structure



(3) Atomic or Orbit structural diagram



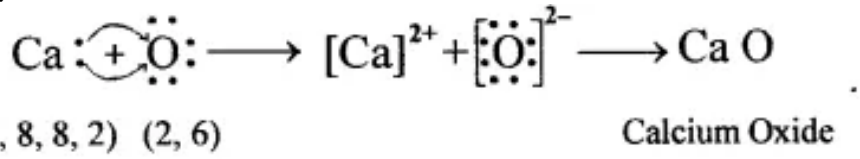
(b) Formation of Calcium Oxide

(1) Ionic Equation

$$Ca - 2e^- \longrightarrow Ca^{2+} \quad \text{(oxidation)}$$
$$(2, 8, 8, 2) \qquad (2, 8, 8)$$
$$O + 2e^- \longrightarrow O^{2-} \quad \text{(reduction)}$$
$$(2, 6) \qquad (2, 8)$$

$$Ca + O \longrightarrow Ca^{2+} + O^{2-} \longrightarrow CaO$$

(2) Electron dot structure:



(3) Atomic Or Orbit Structural Diagram

……

……

Fill in the blanks with the appropriate word /s from the brackets.

Question 13(1).

NaCI an electrovalent compounds is formed as a result of transfer of…….. (one, two, three) valence electrons from metallic sodium to non-metallic chlorine atom. CaO is similarly formed as a result of transfer of…… (one, two, three) valence electron/s from metallic calcium to non-metallic oxygen and magnesium chloride by transfer of…….. (one, two, three) valence electron/s from …….. (one, two) magnesium atom/s to…….. (one, two) chlorine atom/s.

Answer:

NaCI an electrovalent compounds is formed as a result of transfer of **one** valence electrons from metallic sodium to non- metallic chlorine atom. CaO is similarly formed as a result of transfer of **two** valence electron/s from metallic calcium to non-metallic oxygen and magnesium chloride by transfer of **two** valence electron/s from **one** magnesium atom/s to **two** chlorine atom/s.

Question 13(2).
Covalent compounds are formed by sharing electron pairs between non-metallic atoms. Non-metallic atoms having….,……. valence electrons (4, 5, 6, 7) share one, two or three pairs of electrons respectively.
Answer:
Covalent compounds are formed by sharing electron pairs between non-metallic atoms. Non-metallic atoms having 7,6, 5 valence electrons (4, 5, 6, 7) share one, two or three pairs of electrons respectively.

Question 14.
Define or explain the terms:

1. covalent or molecular bond
2. covalent or molecular compound
3. Covalency
4. Shared pair of electrons.

Answer:
(1) Covalent bond: The chemical bond formed due to mutual sharing of electrons between the given pairs of atoms of non-metallic elements. In the bond formed by a shared pair of electrons, each bonding atom contributing one electron to the pair. Depending on number of electron pairs shared bond is single [-], double [=], or triple [≡] covalent.

(2) Covalent compound: The chemical compound formed due to mutual sharing of electrons between the given pairs of atoms forming a covalent bond is called covalent compound.

(3) Covalency: The number of electron pairs which an atom shares with one or more atoms of the same or different kind to achieve stable electronic configuration is called covalency.

(4) Shared pair of electrons: A pair of electrons which is shared between two atoms resulting the formation of a covalent bond is called a shared pair of electrons.

Question 15.
Give two differences between the covalent compounds – methane (non-polar) and HCl (polar)
Answer:
Non-polar covalent compound(Methane,CH_4)

1. Covalent compounds are said to be non-polar when shared pair of electrons are equally distributed between the two atoms.
2. No charge separation takes place.The covalent molecule is symmetrical and electrically neutral.

……

Polar covalent compound (HCl)

1. Covalent compounds are said to be polar when shared pair of electrons are unequally distributed between the two atoms.
2. Charge separation takes place.The atom which attracts electrons more strongly develops a slight negative charge while the other develops a slight positive charge.
   ……..

Question 16.
Explain with the help of –
(1) electron dot diagram
(2) atomic or orbital structural diagram – the formation of the following molecules, stating the valency of each element involved.
(a) Hydrogen
(b) Chlorine
(c) Oxygen
(d) Nitrogen
(e) Water
(f) Methane
(g) Carbon tetrachloride
(h) Ammonia
(i) Carbon dioxide
(at. nos. H = 1, C = 6, N = 7, O = 8, Cl = 17)
Answer:
(a) Formation of Hydrogen molecule (H_2) (Non-polar covalent compound).
Atom $_1{}^1H$ – it needs one electron to achieve a stable configuration

1. **Electron Dot Structure**
   .....
2. **Atomic or orbit structural diagram**
   .....

(b) Formation of Chlorine (Cl_2) (non-polar covalent compound)
Chlorine atom Cl electronic configuration (2,8,7)— It needs one electron to attain stable configuration

1. **Electron Dot Structure**
   .....
2. **Atomic or orbit structural diagram**
   .....

(c) Formation of Oxygen molecule (O2)
Oxygen atom $_8{}^{16}O$ electronic configuration 2,6
When two oxygen atoms contributes two electrons so as to have two shared pair of electrons between them thereby both atoms attain stable octet structure resulting in the formation of double bond [O = O] between them.

1. **Electron Dot Structure**
   …….
2. **Atomic or orbit structural diagram**
   ……

(d) Formation of Nitrogen Molecule (N_2) (non-polar covalent compound)

Nitrogen electronic configuration (2,5). When two nitrogen atoms come close, each contributes three electrons to share to attain stable octet structure resulting in formation of triple bond (N = N) – N_2.

1. **Electron Dot Structure**
   ……
   Atomic or orbit structural diagram
   ……

(e) Formation of Water molecule (H_20)

Hydrogen $_1{}^1H$ electronic structure 1.

Oxygen $_8{}^{16}O$ electronic structure 6 needs two electrons to complete octet.

When a molecule of water is formed, each of two hydrogen atoms share one electron pair with oxygen atom.

1. **Electron Dot Structure**
   ……
2. **Atomic or orbit structural diagram**
   ……

(f) Formation of Methane moleucle (CH_4)

Carbon atom $_{12}{}^6C$ electronic configuration (2,4)

Hydrogen $_1{}^1H$

When a molecule of methane is formed one atom of C shares four electron pairs, one with each of four atoms of Hydrogen

1. **Electron Dot Structure**
   ….
2. **Atomic or orbit structural diagram**
   ……

(g) Formation of Carbon Tetrachloride (CCl_4)

Carbon $_{12}{}^6C$ (2,4) Carbon needs- four electrons to attain – stable octet.

Chlorine $_{17}{}^{35}Cl$ (2,8,7) Chlorine needs – one electron to attain – stable octet.

1. **Electron Dot Structure**
   ……
2. **Atomic Or orbit Structural Diagram**
   ……

(h) Formation of Ammonia molecule (NH_3)

Electronic configuration of H (Z = 1) and N (Z = 7) are
K L
H(Z= 1): 1,
N(Z=7):2 5

Hydrogen has one electron in its outermost shell and nitrogen has five electrons in its outermost shell.

1. **Electron dot diagram**
   ……
2. **Atomic or orbital structural diagram**
   …….

(i) Atomic or orbital structural diagram

Carbon – C (2,4) Carbon needs- four electrons to attain – stable octet.
Oxygen O (2, 6) Oxygen needs – two electron to attain – stable octet.

1. **Electron Dot Structure**
   ……..
2. **Atomic or orbit structural diagram**
   …..

Question 17 (a).
Give reasons for the following: Molecules of hydrogen and chlorine have single covalent bonds between their atoms while oxygen has a double covalent and nitrogen a triple covalent bond respectively.
Answer:
Hydrogen – Each of the two H atoms contributes one electron so as to have one shared pair of electrons between them.Both atoms attain stable – duplet structure, resulting in the – formation of a -single covalent bond [H-H] between them.
……
Chlorine – Each of the two Cl atoms contributes one electron so as to have one shared pair of electrons between them. Both atoms attain stable – octet structure, resulting in the – formation of a – single covalent bond [Cl – Cl] between them.
……..
Oxygen – Each of the two O atoms contributes two electron so as to have two shared pair of electrons between them. Both atoms attain stable – octet structure, resulting in the – formation of a – double covalent bond [O = O] between them
……
Nitrogen- Each of the two N atoms contributes three electron so as to have three shared pair of electrons between them. Both atoms attain stable – octet structure, resulting in the – formation of a – tripple covalent bond [N = N]

between them.
……

Question 17 (b).
A molecule of methane has four single covalent bonds.
Answer:
Methane – Non – polar covalent compound
….
When a molecule of 'CH.' is to be formed –
One atom of carbon thus – shares four electron pairs – one with each of the four atoms of hydrogen.
Formation of Methane Molecule can be represented by
Atomic or orbit structural diagram
……

Question 17 .
Formation of ammonia involves one atom of nitrogen sharing three electron pairs one with each of the three atoms of hydrogen.
Answer:
Ammonia – Polar covalent compound
…..

When a molecule of 'NH_3' is to be formed – One atom of nitrogen shares three electron pairs one with each of the three atoms of hydrogen.
Formation of Ammonia Molecule can be represented by Atomic or orbit structural diagram
….

Question 18.
Explain the terms
(a) Lone pair of electrons.
Ans. Lone pair of Electrons – are a pair of electrons not shared with any other atom.

(b) Coordinate bond. Explain diagrammatically the lone pair effect of:

(1) The nitrogen atom of the ammonia molecule leading to the formation of ammonium ions $(NH_4)^+$
Answer:
Coordinate Bond: It is a type of covalency which involves one of the combining atoms contributing both of the shared electrons, i.e. a bond formed by a shared pair of electrons with both electrons coming from the same atom.
Formation of Ammonium Ion – NH_4^+
……
(2)
The oxygen atom of the H_20 molecule leading to formation of hydronium $(H_2O)^+$ and hydroxyl ions $(OH)^-$

Ans.

Formation of Hydronium Ion $[H_30]+$ and hydroxyl $[OH]^-$ Ions

18.

Give reasons for the following:

Electrovalent compounds are soluble in water, insoluble in organic solvents, good conductors of electricity in molten or aq. solution state, have high melting points and undergo electrolytic dissociation on passage of electric current, while covalent compounds are soluble in organic solvents, insoluble in water, non-conductors of electricity, have low melting points and undergo ionisation on passage of electric current.

Answer:

1. **Solubility — *Soluble – in water, * Insoluble – in organic solvents.**
   Reason: Water [polar solvent] has a high dielectric constant i.e. capacity to weaken the force of attraction, thus resulting in free ions. Organic solvents [non-polar] have low dielectric constants and do not cause dissolution.
2. **Conduction of Electricity —*Solid state – Non-conductors, *Molten or aq. soln. state** – Good conductors
   Reason: Strong electrostatic force keeps ions in fixed position . in the – solid state.
   The force is weakened in the molten state and disappears in soln. state, hence free ions formed migrate to – oppositely charged electrodes.
3. **Melting and Boiling Point** — * High melting point and high boiling point.
   Reason: Strong electrostatic force of attraction between ions. Large amount of energy – required to break the force of attraction.
4. **Electrolysis —** * Can – be electrolysed in molten/aq. soln. state. Reason on electrolysis the ions being charged are attracted towards the respective electrodes.
5. **Dissociation** — * **Undergoes electrolytic dissociation** – on passage of electric current. Process involves – **separation** of ions already present in the ionic compound.
   ……..

Properties of covalent compounds:

1. **Covalent compounds are soluble in organic solvents but insoluble in water.**
   Reason: Organic solvents the benzene, carbon tetrachloride, hexane are non-polar in nature. Non-polar solvents dissolve non-polar covalent compounds (like dissolves like). Thus, water – a polar solvent cannot dissolve non-polar compounds.
2. **Covalent compounds are non-conudctors of electricity.**
   Reason: Non-polar compounds (like CCl_4) contain molecules and not ions. Hence non-polar covalent compounds do not conduct electricity. Polar covalent compounds (like HCl) when dissolved in water produce ions and hence conduct electricity.

3. **Covalent compounds have low melting points.**
   Reason: The intermolecular forces of attraction in covalent compounds are weak van der Waals forces. Thus less amount of energy is required to break these forces of attraction resulting in a lower melting point.
4. Polar covalent compounds undergo ionisation when dissolved in waer. Such a solution can be electrolysed by passing electricity through it.
   Reason: Polar covalent compounds (like HCl) dissolve in polar solvents like water (like dissolves like). This results in ionisation.
   ……..
   When electricity is passed through such a solution, ions migrate towards oppositely charged electrodes and are discharged.
   $2H^+$ (aq) + $2e^-$ → H_2 (g) **At cathode**
   2Cl –(aq) → Cl, (g) + 2e **At anode**

UNIT TEST PAPER-2

1. Give reasons for the following:

Question 1(1).
NH_3 gas a covalent compound does not conduct electricity but its aq. soln. NH_4OH is a weak electrolyte.
Answer:
Ammonia (gas) is a covalent compound.
…….
As there are no ions present in it, it does or conduct electricity.Ammonia gas dissolves in water to give an aqueous solution of ammonium hydroxide.
NH_3 (g) + H_20 (l) → NH_4OH (aq)
Ammonium hydroxide is a weak electrolyte which ionises to a small extent to give ammonium ions and hydroxide ions.
…….
Due to the presence of these ions an aqueous solution of NH_3 gas in water conducts electricity.

Question 1(2).
$MgCl_2$ is soluble in water but insoluble in acetone, while methane is insoluble in water, but soluble in acetone.
Answer:
$MgCl_2$ is an ionic compound. Thus it can easily dissolve in polar solvents like water (like dissolves like). On the other hand it does not dissolve in a non-polar solvent like acetone.
Methane (CH_4) is a non-polar covalent compound. Thus it does not dissolve in polar solvents like water. On the other hand, it can easily dissolves in non-polar solvents like acetone.

Question 1(3).
Iron displaces copper from a solution of a copper salt. The reaction is deemed as a redox reaction.

Answer:
$Fe\ (s) + CuS0_4\ (aq) \rightarrow FeS0_4\ (aq) + Cu\ (s)$
Ionic equation for the reaction can be written as ;
$Fe\ (s) + Cu^{2+}\ (aq) \rightarrow Fe^{2+}\ (aq) + Cu\ (s)$
In this reaction iron loses two electron and is oxidized to Fe^{2+}.
$Fe\ (s) \rightarrow Fe^{2+}(aq)\ (-2e^-)$ (Oxidation)
On the other hand Cu^{2+} gains two electrons and is reduced to copper.
$Cu^{2+}\ (aq) \rightarrow +2e^- \rightarrow Cu\ (s)$ (Reduction)
Thus the given reaction is a redox reaction.

Question 1(4).
A non-metallic atom (at. no. 9) forms a molecule of the same, containing a single covalent bond.
Answer:
Electronic configuration of non-metallic element (say X) with atomic number 9 is ;

K L
X (Z = 9): 2, 7

Thus it requires one electron to complete its octet and attain stable structure of nearest noble gas (Ne). To do this each of the two 'X' atoms contributes one electron so as to have one shared pair of electrons between them. Both atoms attain stable doublet structure, resulting in the formation of a single covalent bond between them as shown below:
…….

Question 1(5).
In the formation of MgO the magnesium atom (at. no. 12) loses two electrons from its valence shell.
Answer:
Electronic configuration of Mg (Z = 12) is
K L M
Mg (Z = 12): 2 8 2

Magnesium is a metal. Its compound with non-metallic oxygen is an electrovalent compound. Therefore, in the formation of magnesium oxide, magnesium atom loses two electrons from its valence shell to attain the stable octet structure of nearest noble gas (Ne).

…….

Question 2.
With reference to a molecule of water, fill in the blanks with the correct word. (at. no. of H = 1, O = 8)
Water is a…… (non-polar/polar) covalent molecule in which the atom of……. (hydrogen/oxygen) attracts electrons more strongly towards itself. The water molecule shows the presence of…… (double/one single/two single) covalent

bond/s and……. (one/two) lone pair of electrons present in the……. (hydrogen/oxygen) atom.

Answer:

Water is a polar covalent molecule in which the atom of oxygen attracts electrons more strongly towards itself. The water molecule shows the presence of two single covalent bond/s and two lone pair of electrons present in the oxygen atom. .

Question 3.

Complete the table given below:

……

Answer:

……

Question 4.

Fill in the blanks with the correct word from the brackets:

1. The bond between two elements in group 17(VTIA) of the periodic table is likely to be……. (ionic/covalent)
   Ans. The bond between two elements in group 17(VILA) of the periodic table is likely to be **ionic.**
2. In the reaction of CL, + 2KI → 2KCl + I_2 the conversion of 21 to I_2 is deemed as…… (oxidation/reduction)
   Ans. In the reaction of Cl_2 + 2K1→ 2KC1 +l_2 the conversion of 21 to I_2 is deemed as **oxidation.**
3. The covalent molecule containing three single covalent bonds is……. (water/methane/ammonia)
   Ans. The covalent molecule containing three single covalent bonds is **ammonia.**
4. The molecule of water combines with a…… (hydrogen atom/proton/hydrogen molecule) to form a hydronium ion.
   Ans. The molecule of water combines with a **proton** to form a hydronium ion.
5. For formation of an electrovalent bond between elements 'X' and 'Y' which are a metal and non-metal respectively,X should have a…… (high/low) ionization potential and'Y' a……. electron affinity.
   Ans. For formation of an electrovalent bond between elements 'X' and ' Y' which are a metal and non-metal respectively, X should have a **low** ionization potential and 'Y' a **high** electron affinity.

Question 5.

Electronic configuration of the following elements are given:

1. Sodium – Na = 2, 8, 1
2. Hydrogen – H = 1
3. Carbon – C = 2, 4
4. Chlorine = Cl = 2, 8, 7 5.
5. Lithium – Li = 2,1

State which of the compounds given below:

1. have high/low boiling points,
2. are soluble/insoluble in organic solvents.A: Hydrogen chloride
   B : Sodium chloride
   C : Sodium hydride
   D : Lithium chloride
   E : Carbon tetrachloride

Answer:
A: Hydrogen chloride – low boiling point; Insoluble in organic solvents.
B: Sodium chloride – High boiling point; Insoluble in organic solvents.
C: Sodium hydride – high boiling point; insoluble in organic solvent
D: Lithium chloride – high boiling point; insoluble in organic solvents
E: Carbon tetrachloride – low boiling; soluble in organic solvents.

Question 6.
A compound has a formula = "H_2 Y". Y denotes a nonmetal. State the following:

1. The electronic configuration of Y.
   Ans. 2,6

2. The valency of Y.
   Ans. 2 (Two)

3. The bonding present in 'H_2Y'
   Ans. Covalent

5. The bonding present in the compound formed between potassium ($^{39}_{19}K$) and 'Y'
   Ans. Ionic
6. The formula of the compound formed between calcium ($^{40}_{20}Ca$) and Y.
   Ans. CaO.