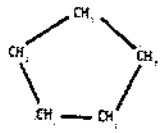
Q.P. 56769 (1)

CHEMISTRY PAPER-I

SET-III

Q. 1 **Do as directed: (any fifteen)** **15 M**

Give IUPAC name of the following compounds:

i 

ii $HOOC(CH_2)_3COOH$ Pentanedioic acid

iii $CH_3 - CO - CH_3$ Propanone

iv CH_3COOH Ethanoic acid

v $CH_3 CO NH_2$ Ethanamide

vi $CH_3 - CH_2 - CH_2 - OH$ 1- Propanol

Explain the term:

vii Co- ordinate bond: A coordinate bond is a covalent bond in which shared pair of electrons is provided by only one of the bonded atoms. One atom is donor &the other is accepter .The bond is also called dative bond

viii Lattice energy: The energy released when gaseous ions are brought from infinity to form a mole of solid substance at 00 K is known as lattice energy

ix Mole Fraction-of any component in solution is defined as the number of moles of that component divided by the total number of moles of all components in solution.

x Buffer range- is the range of pH over which buffer shows maximum buffering capacity and resists any change in its pH on addition of small amount of acid or alkali. pH= pKa±1 for acid buffers and pOH=pKb±1 for basic buffers

xi Primary standard- the substance which after dissolution of exactly weighed compound gives solutions of exactly known concentrations

xii ppb- denotes one part per 1000000000 parts. One part in 10^9.

xiii Lowry's concept of acid-is a compound that can donate proton

xiv Basic Buffers-buffers consisting of a weak base and its salt with strong acid

xv Ionic product of water.- the product of molar concentrations of hydrogen and hydroxyl ions at equilibrium in pure water at a given temperature

Give examples of:

xvi Compound exhibiting intramolecular hydrogen bond- Salicylic acid

xvii Compound exhibiting ionic bond- NaCl , KCl.

Fill in the blanks:

xviii The Bond between NH3 $\longrightarrow$BF3 is called **Co-ordinate bond.**

xix The weak force of attraction present in non-polar molecules is known as **Van-der waal's forces.**

xx The bond angle is BF3 molecule is **120^0**

Q.2 **Attempt the following questions**

A **Draw structures of the following compounds** **8M**

(each structure for 2 marks)

i. Isopentane

$CH_3-CH_2-CH(CH_3)-CH_3$

ii. 1,2,3 Propanetriol $CH_2OH\text{-}CHOH\text{-}CH_2OH$
iii. 2-chloro propanamine $CH_3\text{-}CHCl\text{-}CH_2\text{-}NH_2$
iv. Butane $CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_3$

B State basic rules of IUPAC nomenclature in ketones **7M**

- Ketones contain carbonyl carbon- -C=O
- The IUPAC name of ketone is obtained by replacing the –e of alkane by-one
- EG: Propanone, butanone
- The position of the functional group is assigned lowest possible number.

EG: CH3-CO-CH2-CH3 is named as 2-Butanone and not 3- butanone

- In case of compounds containing more than one ketone group- dione/ trione etc are used

EG: CH3-CO-CH2-CO-CH3 Pentane-2,4-dione

(Rules 4M, Examples with structure 3M)

OR

C **Draw structures of the following compounds** **8M**

(each structure for 2 marks)

i. Hexane CH3-CH2-CH2-CH2-CH2-CH3
ii. Prop-2-enol CH2=CH-CHO
iii. Ethanol CH3-CHO
iv. 2-pentene CH3-CH=CH-CH2-CH3

D **Discuss IUPAC nomenclature of alkyne. Give suitable examples** **7M**

- Select the longest continuous chain of carbon containing carbon – carbon triple bond
- Number the carbon atom from that end which is nearest to the triple bond
- The name of alkyne is derived by replacing suffix 'ane' in the name of parent alkyne 'yne'
- $CH_3\text{-}CH_2\text{-}C{\equiv}C\text{-}CH_3$
- The position of carbon atom from which the triple bond starts is indicated by the smaller number
- The position of branched is indicated by proper numbers.
- Compounds with more than 1 triple bonds are called diyne,triyne and so forth.

(Rules 4M, Examples with structure 3M)

Q.3 Answer the following questions

A **What is Covalent bond? Explain by giving any two examples.** **8M**

Covalent bond: A covalent bond is formed when two atoms attain stability by the sharing of an electron pair each contributing one electron to the electron pair. A covalent bond is represented by a single line. (-)

Give example as Cl_2 molecule is formed between two Cl atoms each sharing one electron for bond formation both Chlorine atoms are bonded by sharing of electron pair & Cl_2 molecule is stable

Covalent bond may be a single or multiple bond –

Eg. Ethylene has double bond , Nitrogen molecule , Acetylene molecule

B **Give a brief account of Non-covalent bond.** **7M**

Non- covalent bond : Non covalent bond does not involve sharing of electrons instead involves electromagnetic interaction s between molecules.

Give different types of Non -covalent bonds & explain with one example each .

OR

C **Draw electron dot structure of any two ionic compounds. State features of ionic bond.** **8M**

In NaCl , Sodium is having (2,8,1) & Chlorine (2,8,7) one electron is donated by Na to become electropositive & Cl accept the one electron become electronegative due to opposite charges there is development of attractive force is called Ionic bond.

In MgCl2 also explain formation of molecule.

Features of ionic bond:

I) Ionic bond containing compound are crystalline in nature.

II) Ionic compound have high melting points.

III) Ionic compounds are bad conductors of electricity in solid state & good conductors in solution state.

IV) Ionic compounds are soluble in polar solvents.

D **Explain the structure of CsCl using ionic bond concept.** **7M**

In CsCl , Cs is electropositive element which donate the electron & Cl is electronegative element which accept the electron & development of attractive force between them to form ionic bond.

It shows a body centred cubic type of arrangement .When Cs^+ ion is surrounded by eight Cl^- ions & vice versa . The coordination is thus 8:8 ,In CsCl the ions at corners are Cl- then there will be a Cs+ ion at body centred position , So it is not Strictly body centred cubic type.

Draw three dimensional structure of CsCl.

Q.4 **Attempt the following questions**

A i. **Explain in brief, the various ways in which concentration of a solute can be expressed.** **4M**

I) volume basis-i) Molarity
ii) Formality
iii) Normality

II) Weight Basis – i) Molality
ii) Molefraction
iii) Milliequivalents, mill moles, ppm,ppb

ii. **What is the molarity of a solution that contains 10g of glucose dissolved in 250 g of water? (Molecular weight of glucose= 180)** **4M**

Molality (m)= no.of moles of solute/no.of kg of solvent
= (g of solute/molecular weight of solute)/number of kg of solvent
=(10/180)/0.250 =0.22mole/kg

B **Discuss physical properties of water.** **7M**

Water is a hydride of oxygen and has higher m.p. b.p., Heat of vaporization and surface tension than do the comparable hydrides of sulfur (H2S) nitrogen (NH3) and most common liquids. These unusual properties are due to strong attraction between adjacent water molecules. (Some values can be mentioned)

1. expansion on freezing
2. high surface tension

3. high heat capacity
4. high solvent power
5. adheres and is cohesive
6.Hydrogen bonding

OR

C i. **Discuss hydrolysis of salt of strong acid and strong base** **4M**

NaCl is a salt of strong acid HCl and a strong base NaOH. When it is dissolved in water, it dissociates completely into its ions.

$NaCl \rightarrow Na^+ + Cl^-$

Water dissociates only slightly as

$H_2O \leftrightarrow H^+ + OH^-$

In puer water, $[H^+] = [OH^-]$and hence pure water is neutral pH=7

The solution of NaCl contains 4 ions; Na^+, H^+, Cl^-, OH^-. The salts of Na^+ and Cl^- have no tendency to react with $OH^-$and H^+ ions of water. This is because the possible products NaOH and HCl are strong electrolytes and tend to dissociate completely in aq.solutions.

$Na^+ + Cl^- + H_2O \leftrightarrow HCl + NaOH$

$Na^+ + Cl^- + H_2O \leftrightarrow H^+ + Cl^- + Na^+ + OH^-$

reactants and products are identical. Na^+ and Cl^- ions exist on both sides of the reaction. This implies that neither the cation nor the anion of the salt reacts with water.

$[H^+] = [OH^-]$ is not disturbed . the solution is therefore neutral and has no effect on litmus. Salt of strong acid and strong base does not undergo hydrolysis.

ii. **Calculate pH of 0.25M HCl** **4M**

HCl is a strong acid, gets completely ionized in the solution.

$[H^+] = 0.25$ mol/dm3

$pH = -\log_{10}[H^+] = -\log_{10} 0.25 = -(1.3979) = 1 - 0.3970 = 0.6021$

D **Show that pH+ pOH= 14** **7M**

The ionic product of water is given by equation

$K_w = [H^+][OH^-] = 1.0 \times 10^{-14}$ at 25^0 C

Taking log on both sides,

$\log_{10}[H^+] + \log_{10}[OH^-] = \log_{10} 10^{-14} = -14$

Multiplying equation by -1

$-\log_{10}[H^+] + \{-\log_{10}[OH^-]\} = 14$

pH+ pOH= 14

students can include definition of pH, pOH ,ionic product of water.

Q.5 **Write short note: (Any three)** **15M**

i **IUPAC nomenclature of carboxylic acids**

(Two types, rulesfor IUPAC nomenclature and two structures with IUPAC name is expected)

Carboxylic acids have –COOH as their functional group.

General formula is RCOOH.

They are further classified as mono, di, tri carboxylic acids depending on the number of –COOH groups present.

IUPAC nomenclature for carboxylic acids is obtained by replacing the parent alkane by –oic.

The longest parent chain with the –COOH group is selected
-COOH bearing carbon is always assigned number 1.
When a compound has two –COOH group, its IUPAC name is obtained by adding suffix-dioic acid to the parent alkane, and by replacing the 'e'

ii **Types of hydrogen bonds**

I) Intermolecular hydrogen bonds ; If hydrogen bond is formed in between different molecules is called intermolecular hydrogen bond.
For example : hydrogen bond between alcohol molecules.
II) Intramolecular hydrogen bonds : If bond formed within a molecule is called intramolecular hydrogen bonding.
For example : Hydrogen bond in P-nitrophenol.

iii **Structure of CH_4 molecule**

In CH_4 molecule Carbon is having four outer most electrons they share these four electrons with four hydrogen atom to form covalent bond . There are four pairs around the central carbon atom in its valence shell .Hence it has a tetrahedral shape with bond angle $109^0 28'$
Draw structure of CH_4 showing tetrahedral shape of molecule.

iv **Interaction of water with polar solutes**

H bonds are readily formed between an electronegative atom (O or N) and a hydrogen atom covalently bonded to another electronegative atom in the same or other molecule.
Refer to fig 2-3 in Lehninger 4 Ed.pg 49
However H atoms covalently bonded to carbon atoms (non electronegative) do not participate in H bonding.
Butanol has polar hydroxyl groups that can form H bonds with other butanol molecules. Hence it has relatively high boiling point (117^0C) in contrast to Butane (- 0.5C)
Uncharged but polar molecules (sugars) dissolve readily in water because of stabilizing effect of many H bonds that form between OH groups or carbonyl oxygen of sugar and polar water molecules. Alcohols , aldehydes ketones , all form H bonds as do compounds containing N-H bonds and molecules containing such groups tend to be soluble in water.
Refer to fig 2-4 in Lehninger 4 Ed.pg 50
H bonds are strongest when the bonded molecules are oriented to maximize electrostatic interactions. This happens when H atom and 2 atoms that share it are in straight line. H bonds are thus highly directional.
Refer to fig 2-5in Lehninger 4 Ed.pg 49

v Consider an acidic buffer composed of weak acid HA and its salt BA. The acid being weak dissociates only slightly whereas the salt dissociates completely.

$HA_{(aq)} \leftrightarrow H^+_{(aq)} + A^-_{(aq)}$

$BA_{(aq)} \rightarrow B^+_{(aq)} + A^-_{(aq)}$

The dissociation constant of the acid is given by

$K_a = [H^+][A^-] / [HA]$

Hence, $[H^+] = \frac{[HA]}{[A-]} K_a$

The equilibrium concentration [HA] of weak acid is nearly equal to its initial concentration because it is dissociated only slightly and its dissociation is further suppressed by common A- ions provided by the salt. The equilibrium concentration [A-] is equal to the initial conc. Of the salt since it is completely dissociated.

[H+]= Ka [Acid]/[Salt]

Where [Acid]=[HA]= initial conc of acid and [salt]= [A-] =initial conc of salt.
Taking negative log of both sides,

$-\log_{10}[H+] = -\log_{10} Ka - \log_{10}[acid]/[salt]$

$pH = pKa + \log_{10}[salt]/[acid]$

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