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CHEMISTRY PAPER-I

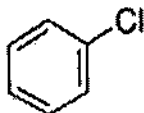
SET-II

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

Give IUPAC name of the following compounds:

- i $\text{CH}_3\text{-CH}_2\text{-Br}$ Bromo ethane
ii $\text{CH}_3\text{-CO-CH}_3$ Propanone
iii $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-COOH}$ Butanoic acid

iv



Chlorocyclohexane

v $\text{CH}_3\text{-O-C}_2\text{H}_5$ Methoxy ethane

vi $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_3$ Butane

Explain the term:

- vii Non- Covalent bond : Does not involve sharing of electrons instead involves electromagnetic interaction between molecules
viii Dipole– induced dipole interaction: The interaction takes place between a polar molecule having permanent dipole moment & non polar molecule with zero dipole moment
ix Normality-is defined as number of equivalents of solute present in 1dm³ of the solution.
x Buffer- is defined as a solution which has a capacity to resist a change in pH on addition of small quantity of an acid or a base.
xi Standard solution- a solution of exactly known concentration
xii Milliequivalents-is 1/1000 of an equivalent
xiii Strong acid- acid which dissociates completely in solution
xiv ppm-denotes one part per 1,000,000 parts ie ppm= gm of solute/gms of solution $\times 10^6$
xv Dissociation Constant – is defined as an equilibrium constant for the dissociation equilibrium of the acid or the base

Give examples of:

- xvi Covalent compounds: CH_4 , NH_3 , H_2O
xvii Compound exhibiting hydrogen bond: Alcohols, Salicylic acid.

Fill in the blanks:

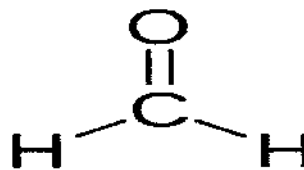
- xviii The shape of KCl molecule is **Octahedral**.
xix The bond formed in R-COOH molecules in between hydrogen & oxygen is called **Hydrogen bond**
xx The bond angle in NH_3 molecule is **107°48'**

Q.2 Attempt the following questions

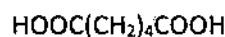
A Draw structures of the following compounds (each structure for 2 marks)

8M

i. Methanal-



ii. Hexanedioic acid





- iii. 2-chloro propanamine $\text{CH}_3\text{-CHCl-CH}_2\text{-NH}_2$
- iv. Sodium methanoate H-CO-ONa

B State basic rules of IUPAC nomenclature in carboxylic acids **7M**

IUPAC nomenclature of carboxylic acids

- 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.
- Carboxylic acids have -COOH as their functional group. General formula is RCOOH.
- EG: HCOOH : Methanoic acid

CH_3COOH : Ethanoic acid

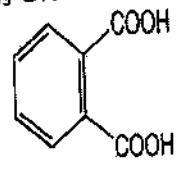
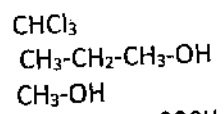
- When a compound has two -COOH group, its IUPAC name is obtained by adding suffix-dioic acid to the parent alkane, and by replacing the 'e'
- They are further classified as mono, di, tri carboxylic acids depending on the number of -COOH groups present.
- HOOC-COOH = dicarboxylic acid; ethanedioic acid

(Rules, types and explanation 4M, examples with structure- 3M)

OR

C Draw structures of the following compounds **8M**
(each structure for 2 marks)

- i. Trichloromethane
- ii. Propan-1-ol
- iii. Methanol



- iv. Benzene 1,2-dicarboxylic acid

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

Alkenes or olefins have a general formula- C_nH_{2n}

- The longest parent chain with double bond is selected. Numbering is done in such a way that the carbon atom with the double bond would get a minimum possible number.
- The alkenes are derived by replacing the suffix- ane of parent alkane by -ene. Eg: Alkene of ethane would be Ethene. Alkene of Propane would be Propene .

- First two alkenes that is Ethene and Propene have only one type of structure
- Butene and higher alkenes exists in different isomeric forms depending on the position of the double bond.
- If alkenes contain more than one double bond, prefixes like di, tri are written before suffix ene.
- Branched or substituted alkenes - carbon bearing double bond should get minimum possible number.
- Examples for each rule has to be given

(Rules- 4M, example with structures- 3M)

Q.3 Answer the following questions

A What is ionic bond? Explain by giving any two example. **8M**

Ionic bond: The strong electropositive & strong electronegative elements combine form compounds involving ionic bonds. The strong electropositive element lose electrons which are accepted by strong electronegative elements due to this transfer of electrons, former attains positive charge & become a cation whereas later attains a negative charge to form an anion. The electrostatic force of attraction between the oppositely charged ions are called ionic bond.

Give any two example such as NaCl & KCl

B Explain the nature of Co-ordinate bond using suitable example. **7M**

Co-ordinate bond: When both the electrons used for sharing between the two atoms are contributed by a single atom, the covalent bond formed is known as the co-ordinate covalent bond or dative bond.

Co-ordinate bond formed when combining atoms has lone pair of electrons in addition to its completed octet & the other atom short of these electrons.

Give example of compounds having Co-ordinate bond with explanation

OR

C Explain the structure of NaCl using ionic bond concept. **8M**

Sodium & Chlorine react together to form NaCl. In which outer electrons of sodium atom transferred to chlorine to produce Na^+ & Cl^- . They attracted towards each other due to coulombic forces of attraction is called ionic bond.

Structure of NaCl is octahedral arrangement. Each Na^+ ion is surrounded by six Cl^- ion at the corners of octahedron & similarly Cl^- ion is surrounded by six Na^+ ions. The coordination number is 6:6. This structure is regarded as cubic close packed array of Cl^- with Na^+ ions occupying all the octahedral holes.

Draw three dimensional structure of NaCl

D Describe the shape of Beryllium dichloride & Boron trifluoride. **7M**

In BeCl_2 the central atom of Be possess four electrons in its valence shell (two electrons of Be & one electron of two Cl atom) These four electrons constitute two electrons pairs which will arrange themselves linearly to maximise the distance between them. Thus BeCl_2 in the gas phase has a linear structure with a bond angle 180° .

In BF_3 the central atom is Boron has six electrons in its valence shell (3 electrons of Boron & one each electron of F-atom). The six electrons form three electron pairs which will arrange themselves at 120° to maximise their distance apart thus has regular geometry Trigonal planar

Draw structures of BeCl_2 & BF_3 .

Q.4 Attempt the following questions

A i. Explain briefly the conditions to be followed by reaction between titrant and titrand. **4M**

1. It must be simple and must be possible to express the reaction by a chemical equation. The substance should completely react with the standard solution in stoichiometric proportion.

2. The reaction should be instantaneous.

- 3. The reaction should be irreversible under conditions of titration.
- 4. The indicator should sharply define the end point.

ii. **How will you prepare 0.5 dm³ of 0.1 N NaOH?**

(Molecular weight of NaOH=40)

4M

1N NaOH= 40g in 1 dm³

1N NaOH= 20g in 0.5 dm³

0.1N NaOH= 2g in 0.5 dm³

B **How weak interactions are crucial to macromolecular structure and function? Explain with examples.**

7M

Four types of Non covalent (weak) interactions are Hydrogen bonds, ionic interactions, Hydrophobic interactions and Van der Waals interactions. These interactions are continuously formed and broken. Cumulative effect of many such interactions can be very significant. Eg non covalent bonding of an enzyme to its substrate may involve several H bonds one or more ionic interactions. Formation of each of these weak bonds contributes to a net decrease in the free energy of the system. The dissociation of two biomolecules (Enzyme and its bound substrate) associated non covalently through multiple weak interactions requires all these interactions to be disrupted at the same time. As interactions fluctuate randomly, such disruptions are very unlikely. The molecular stability shown by 5 or 20 weak interactions is therefore much greater.

Macromolecules such as proteins, DNA, RNA contain many sites of potential H bonding or ionic, van der Waals or hydrophobic interactions. The most stable (native) structure is usually that in which weak bonding possibilities are maximized. Folding of single polypeptide or poly nucleotide chain into its 3D structure is determined by this principle. The other examples are binding of an antigen to specific antibody, hormone or a neurotransmitter to its cellular receptor protein. When structure of protein such as hemoglobin or RNA, DNA is determined by X-ray crystallography, water molecules are found to be tightly bound to the crystal structure. Tightly bound water molecules are essential to their functioning. In photosynthesis light drives protons across a biological membrane as electrons flow through a series of electron carrying proteins. Cytochrome f has a chain of five bound water molecules that may provide a path for protons to move through membrane. Bacteriorhodopsin uses a chain of bound water molecules in the transmembrane movement of protons. The two strands running in opposite direction of the double helix structure of DNA are held together by H bonds and hydrophobic interactions. The H bonds are formed between the base pairs of anti parallel strands. Phosphate-phosphate electrostatic repulsion is diminished in water by high dielectric constant of water. High water activity favors B form of DNA, reduced water activity leads to transition from B to C and A form and if sequence permits to D and Z DNA forms.

OR

C i. **Give applications of buffer solutions.**

4M

i. Penicillin preparations are stabilized by addition of Sodium citrate as buffer.

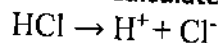
ii. Sodium benzoate is added as buffer to preserve jams and jellies.

iii. When citric acid is added to milk of magnesia magnesium citrate is formed. It acts as a buffer to stabilize milk of magnesia.

iv. In qualitative analysis, pH of 8 to 10 is required for precipitation of

IIIA group radicals. It is maintained by $\text{NH}_4\text{OH}/\text{NH}_4\text{Cl}$ buffer.
 v. buffer solutions are important to biological systems. Eg blood

ii. Calculate pH of 0.015 M HCl



$$[\text{H}^+] = 0.015\text{M}$$

$$\text{pH} = -\log_{10} [\text{H}^+] = -\log_{10} (1.5 \times 10^{-2})$$

$$= -\log_{10} 1.5 - \log_{10} 10^{-2}$$

$$= 2 - 0.1761 = 1.8239$$

4M

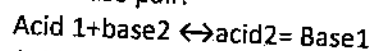
D

Elaborate Bronsted Lowry Concept and Lewis Concept of acid and bases.

7M

Bronsted – Lowry acid is defined as a substance that can donate proton, Base is a substance that can accept proton. Acid is proton donor and base is proton acceptor.

A proton donor and its corresponding proton acceptor make up a conjugate acid-base pair.



Acids strength would depend upon the ease with which it can donate proton. E.g. HCl, its conjugate base Cl^- is a weak base. Not very good proton acceptor. In solutions HCl is therefore completely ionized to produce H^+ and Cl^- . HCl is a strong acid because its conjugate base is weak.

In CH_3COOH , conjugate base CH_3COO^- is stronger and binds the proton much more tenaciously. Therefore, in solution acetic acid is not fully ionized. It's a weak acid because its conjugate base is strong.

Alkali- NaOH is not a Bronsted base because as a molecule it has little ability to accept proton. NaOH can act as base solely because upon ionization it give rise to OH^- ions which are good proton acceptors. NaOH and other metallic hydroxides act as bases by proxy. They are known as alkalis.

Lewis Theory – acid is a compound which can accept a pair of electrons from base. (electrophile)

Base is a compound which can donate an electron pair to an acid. (nucleophile)

Q.5

Write short note: (Any three)

i IUPAC nomenclature of aldehydes

15M

- Aldehydes contain carbonyl carbon- $-\text{CHO}$
- The IUPAC name of aldehydes is obtained by replacing the $-e$ of alkane by $-al$

- EG: Propanal, butanal

EG: $\text{CH}_3\text{-CHO}$ Ethanal

- In case of compounds containing two aldehyde group- term is dial used

EG: $\text{CHO-CH}_2\text{-CH}_2\text{-CHO}$ Butanedial

(Rules 3M, Examples with structure 2M)

ii

Van-der Waals forces

There is presence of forces of attraction & repulsion that are not ionic or covalent are postulated by Van der waal's forces. Such forces are arising in number of ways are called as van der waals forces.

Example: dipole-dipole interaction in polar molecules are type of Van der waal's forces.

Attractive forces also occur between non polar molecules.



These forces are due to momentary polarisation of the molecule.

iii **Structure of H₂O molecule**

In H₂O molecule Oxygen is central atom .It has six outer electrons .two of these electrons form bond with H-atom thus completing the octed .The other four outer electrons on oxygen are non bonding. Thus H₂O has eight outer electrons .four electron pairs .

Hence structure is based on tetrahedral geometry. It have bond angle 104°27' . Shape of H₂O molecule is distorted to angular or bent.

iv **Buffer capacity and properties of Buffer**

i) pH of buffer solution does not change appreciably upon addition of small amount of strong acid or base.

ii) pH of buffer solution does not depend on the volume of the solution.

Hence buffer solutions can be diluted without change in pH.

iii) pH of buffer solution remains constant even if its kept for long time.

Buffer capacity- The magnitude of buffer action of a given buffer to change in pH on addition of strong acid or strong base is called buffer capcity. Buffer capacity is maximum when pH= pKa for acid buffers and pOH= pKb for basic buffers.

v **Hydrophobic interactions**

Non polar compounds like benzene or hexane are hydrophobic- they are unable to undergo energetically favorable interactions with water molecules. Amphipathic compounds contain regions that are polar and regions that are non polar. When such compound is mixed with water, polar hydrophilic region interacts favorably with the solvent and tends to dissolve. But the non polar hydrophobic region tends to avoid contact with water. Nonpolar regions of molecules cluster together to present the smallest hydrophobic area to aqueous solvent and polar regions are arranged to maximize their interactions with solvent. These stable structures are called Micelles. The forces that hold non polar regions together are called hydrophobic interactions. Eg. Proteins, pigments, certain vitamins sterols and phospholipids of membrane. Structures composed of these molecules are stabilized by hydrophobic interactions. Hydrophobic interactions among lipids and between lipids and proteins are most important determinant of structure of biological membranes. Hydrophobic interactions between nonpolar amino acids stabilize 3D structure of proteins.
