Meghalaya Board
Class XII
Chemistry
Sample Paper 1 – Solution

PART-I

1.

(a)

(i) Based on the shape, structure and amino acid composition of the binding site, the receptors shows selectivity for the chemical messengers. Hence, different receptors in the body interact with different chemical receptors.

(b)

(iv) Hexamethylenediamine reacts with adipic acid to give Nylon-6,6 i.e a condensation polymer formed by the joining of the monomer units with loss of water molecule

(c)

(iv) The amino acid which is not optically active is glycine, since the ɑ-carbon atom is asymmetric.

(d)

(ii) Fe and HCl are preferred because $FeCl_2$ formed gets hydrolysed to release hydrochloric acid during the reaction. Thus only small amount of hydrochloric acid is required to initiate the reaction.

(e)

(ii) Iodoform test is a diagnostic test for the presence of '$-COCH_3$' group. A positive test of Iodoform yields a bright yellow colour on reaction of methyl ketones.

(f)

(ii) Because 3^o haloalkanes like tert-butyl bromide (option a) give alkenes and not ethers when treated with a strong base like sodium ethoxide.

(g)

(ii)Alcoholic solution of KOH is used for dehydrohalogenation of an haloalkane and results in the formation of Alkenes

(h)

(ii) IUPAC nomenclature for $[Ni(CO)_4]$ is Tetracarbonylnickel(0).The ligands are named first followed by the name of the metal. The oxidation number of the metal is written in the bracket in Roman numerals

PART- II

2. The co-ordination number of atoms in BCC lattice is 8, in HCP lattice 12, in CCP lattice 12 and in simple lattice it is 6

3. The molal elevation constant of the solvent is defined as the elevation in its boiling point when one mole of non-volatile solute is dissolved per kilogram (1000g) of solvent. Its unit is K.kg mol^{-1}.

4. Inert electrolytes are used in a salt bridge because they do not chemically react with the solution in either of the compartment and they do not interfere with the net cell reaction also

5. The arrangement of atoms corresponding to energy maxima (threshold energy) is called transition state or activated complex

6. If colloids are not separated from impurities the colloids will be unstable. Ionic impurities precipitate the colloid and so it is important to purify colloids

7. The less reactive metals exist in native state in nature. These metals lie below hydrogen in the activity series. Examples are gold, silver, platinum etc.

8. The electronegativity of an atom depend on the size of an atom and the nuclear charge.

9. The most stable oxidation state of Lanthanides is +3

PART-III

10. This type of isomerism arises from the interchange of ligands between cationic and anionic entities of different metal ions present in a complex. When both positive and the negative ions of a salt are complex ions and the two isomers differs in the distribution of ligands in the cation and the anion; it is Coordination isomerism. Example: $[Co(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][Co(CN)_6]$.

11. Chloroform is oxidized slowly by air in the presence of light to an extremely poisonous gas, carbonyl chloride, also known as Phosgene

$$2CHCl_3 + O_2 \xrightarrow{\text{light}} \underset{\text{Phosgene}}{2COCl_2} + 2HCl$$

Hence it is kept closed in dark colored bottles.

Or

The stereoisomers related to each other as nonsuperimposable mirror images are called **enantiomers.**
For example: 2-chloro butane ($CH_3CH_2\ C^*H\ (Cl)\ CH_3$).
Here the carbon atom marked is the chiral centre and posseses four different groups.

12. The lower members of alcohols are highly soluble in water but the solubility decreases with increase in molecular weight. As the size of the molecule increases, the alkyl group becomes larger and thus prevents the formation of hydrogen bonds with water molecule and hence solubility decreases as there is increase in length of carbon chain.

13. Propanone on treatment with ethyl magnesium bromide forms an addition compound which upon hydrolysis yields 2-methyl-butan-2-ol.

14. Amines when treated with water it forms alkyl or aryl ammonium hydroxides which ionize to furnish hydroxyl ions.

$$RNH2 + H2O \longrightarrow RNH3OH \longrightarrow RNH3+ + OH-$$

15. Nucleic acids are biopolymers and the repeating unit in a nucleic acid is a nucleotide. All nucleotides on hydrolysis give a mixture of three different types of compounds. These are sugar molecule, heterocyclic nitrogenous bases and phosphoric acid.

16. PMMA is polymethylmethacrylate. PAN stands for Polyacrylonitrile and PVC is Polyvinylchloride

17. Antagonists are the drugs that bind to the receptor site to inhibit its function and are useful when blocking of message is required. Agonists are the drugs that mimic the natural messenger by switching on the receptor and are useful when there is lack of natural chemical messenger.

PART-IV

18. The stacking of two close packed anion layers produces 2 types of voids or holes. One set of holes are octahedrally coordinated by 6 anions, the second set are tetrahedrally coordinated by 4 anions. Six particles form the octahedral void 4 in one plane and one above and one below. If the radius of the bigger ion which is generally the anion is R and of the smaller ion r then the radius ratio = 0.414. Similarly for a perfect fit of a cation into the tetrahedral sites it can be shown that r_{cation}/r_{anion} = 0.225.

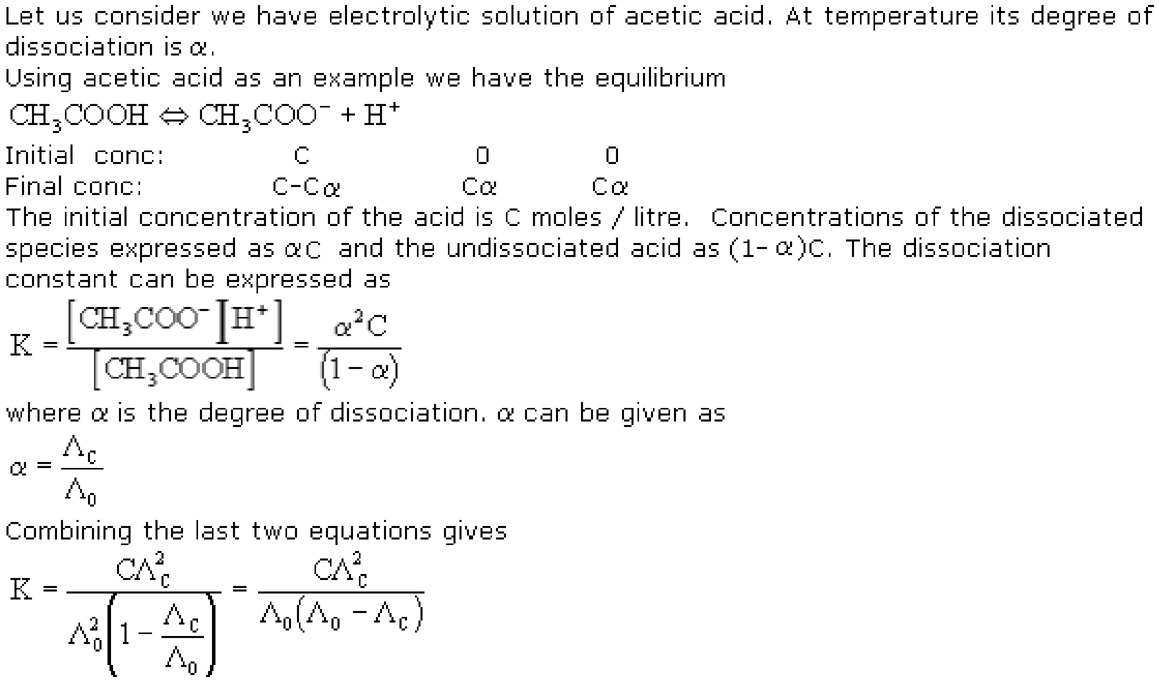
19. If we add a nonvolatile solute to that liquid, the amount of surface area available for the escaping solvent molecules is reduced because some of that area is occupied by solute particles. Therefore, the solvent molecules will have a lower probability to escape the solution than the pure solvent. That fact is reflected in the lower vapor pressure for a solution relative to the pure solvent. That statement is only true if the solvent is nonvolatile. If the solute has its own vapor pressure, then the vapor pressure of the solution may be greater than the vapor pressure of the solvent

20. According to electrochemical series we find that for half cell,

$$F_2\ (g) + 2e^- \rightarrow 2F^-(aq);\ E^O = +2.87$$

This is the highest value of reduction potential in electrochemical series. This implies that F^- cannot be oxidized by any chemical species because no element has reduction potential higher than this. F^- Ion can, therefore be only electrolytic ally oxidized.

Or



Let us consider we have electrolytic solution of acetic acid. At temperature its degree of dissociation is α.

Using acetic acid as an example we have the equilibrium

$$CH_3COOH \Leftrightarrow CH_3COO^- + H^+$$

Initial conc:	C	0	0
Final conc:	C-Cα	Cα	Cα

The initial concentration of the acid is C moles / litre. Concentrations of the dissociated species expressed as αC and the undissociated acid as (1- α)C. The dissociation constant can be expressed as

$$K = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]} = \frac{\alpha^2 C}{(1-\alpha)}$$

where α is the degree of dissociation. α can be given as

$$\alpha = \frac{\Lambda_C}{\Lambda_0}$$

Combining the last two equations gives

$$K = \frac{C\Lambda_C^2}{\Lambda_0^2\left(1-\frac{\Lambda_C}{\Lambda_0}\right)} = \frac{C\Lambda_C^2}{\Lambda_0(\Lambda_0-\Lambda_C)}$$

21. The rate equation for a first order reaction is:

$$K = \frac{2.303}{t}\log\frac{[R_0]}{[R]}$$

At $t_{1/2}$ $[R] = \frac{[R_o]}{2}$

$$\Rightarrow k = \frac{2.303}{t1/2}\log\frac{[R_0]}{[R]/2}$$

$$\Rightarrow t_{1/2} = \frac{2.303}{k}\log 2$$

$$\Rightarrow t_{1/2} = \frac{2.303}{k}\times 0.301$$

$$\Rightarrow t_{1/2} = \frac{0.693}{k}$$

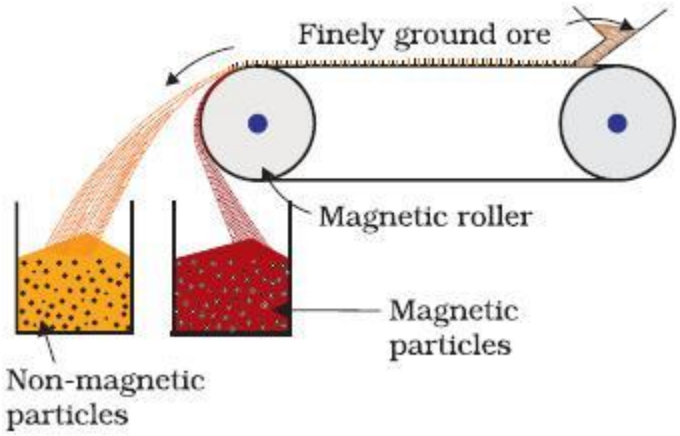
22. There are three dispersion methods:

(a) Mechanical dispersion - Suspension dimension are grinded in colloidal mill or ultrasonic disintegrator to colloidal dimensions.

(b) Electrical disintegration- Metal sols are prep by making electrode of the metal and immersed in dispersion medium and a electric arc is struck(involves dispersion plus condensation).

(c) Peptization- Precipitate is converted into colloids sol by shaking in dispersion medium with an electrolyte called peptizing agent. e.g. $Fe(OH)_3$ ppt + $FeCl_3$. Fe^{+++} is absorbed on $Fe(OH)_3$ and breaks into colloids.

23. Haematite and Magnetite ores can be concentrated by magnetic separation method.



24. There is an increase in radii from the first (3*d*) to the second (4*d*) series of the elements but the radii of the third (5*d*) series are virtually the same as those of the corresponding members of the second series. This phenomenon is called Lanthanoid contraction. The possible reason for that is the intervention of the 4*f* orbitals which must be filled before the 5*d* series of elements begins. The imperfect shielding of one 4*f* electron by another result in the decrease in the size of the entire $4f^n$ orbitals as the nuclear charge increases along the series.

25. Co-ordination compounds exhibits color, which is attributed to the crystal field theory, corresponding to the d-d transition of elements. Say for example, excitation of an electron from the empty state say for example $e_{.g}$., will absorb light that will excite the electron from t_{2g} to e_g as in case of $[Ti(H_2O)_6]^{3+}$. When light corresponding to the energy of the yellow-green region is absorbed by the complex, this would excite the electron from t_{2g} level to the e_g level ($t_{2g}^1eg^0$-> $t_{2g}^0e_g^1$). Thus the complex is violet in color.

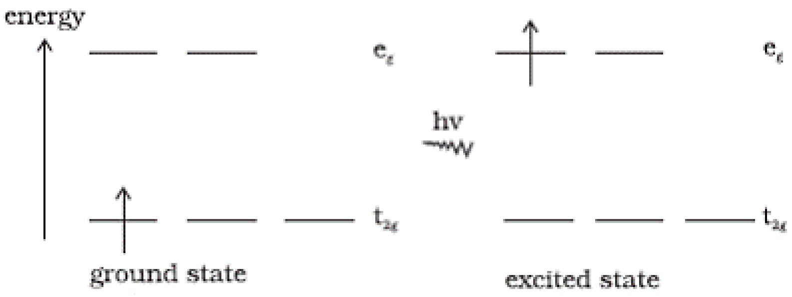
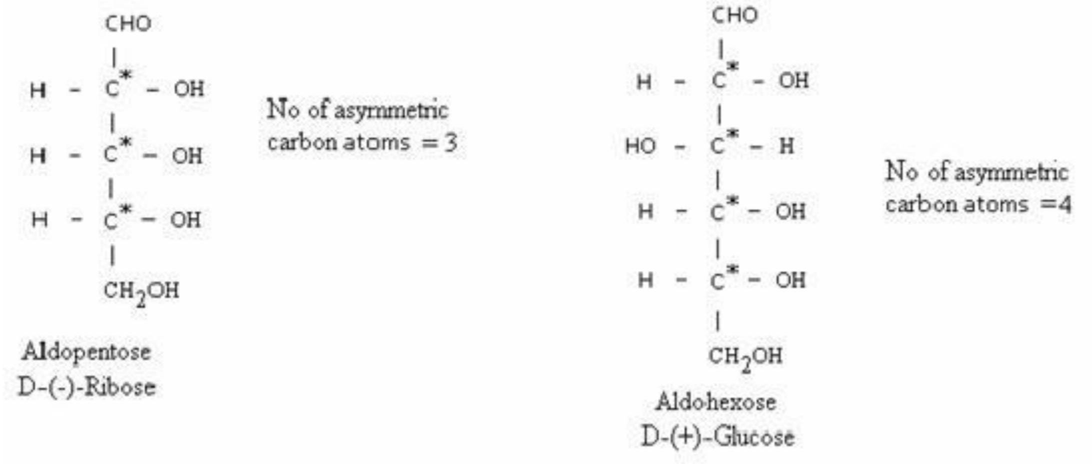


Fig.9.10: Transition of an electron in $[Ti(H_2O)_6]^{3+}$

But in the absence of ligand there is no crystal field splitting and substance become colourless as in case of $[Ti(H_2O)_6]Cl_3$, when water molecules are removed it becomes colourless.

26. The open chain structures of an aldopentose and aldohexose are:



PART-V

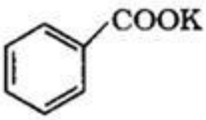
27.

(a)

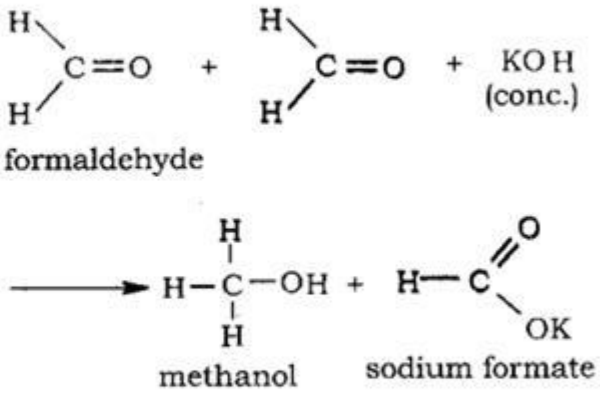
(i) Cyclohexyldiene cyclohexane:

(ii) BH_3,H_2O_2/OH^-,PCC

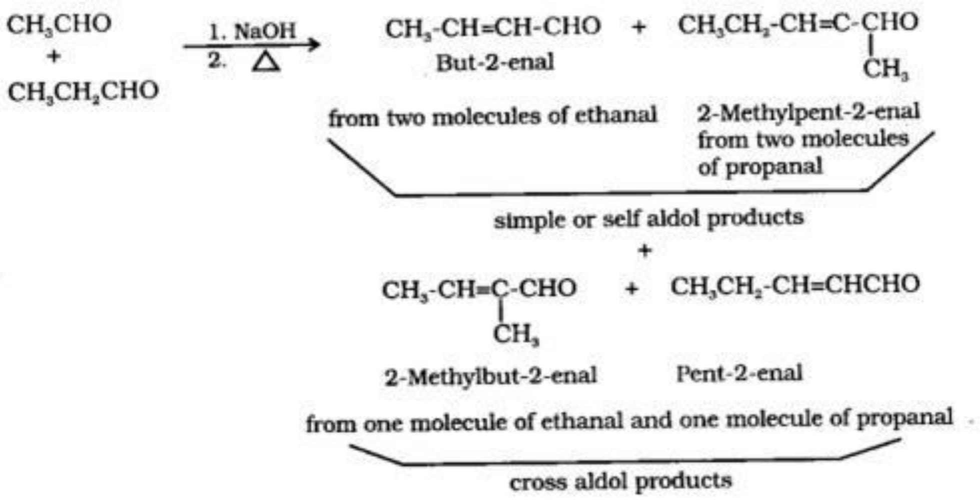
(iii) Salt of benzoic acid:

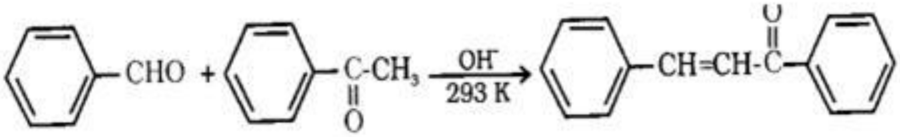


(b) (i) Cannizzaro reaction:Aldehydes which do not have an α-hydrogen atom, undergo self oxidation and reduction reaction on treatment with a concentrated alkali.



(ii) Cross aldol condensation:When aldol condensation is carried out between two different aldehydes and /or ketones, it is called Cross aldol condensation.





Or

(a)

(i) Two alkyl groups present in ketones reduce the positive charge on carbon atom of the carbonyl group more effectively than in aldehydes hence aldehydes are more reactive than ketones towards nucleophiles / or sterically, the presence of two relatively large substituents in ketones hinders the approach of nucleophile to carbonyl carbon than in aldehydes having only one such substituents.

(ii) Because of the absence of hydrogen bonding in aldehydes and ketones, their boiling points are lower than those of the corresponding acids and alcohols.

(iii) Because of the presence of the sp^2 hybridised orbitals (or π-bond) of carbonyl carbon, aldehydes and ketones undergo a number of addition reactions.

(b)

(i) <u>Acetaldehyde and benzaldehyde:</u>Acetaldehyde gives yellow ppt of Iodoform (CHI_3) on addition of NaOH / I_2 whereas benzaldehyde does not give this test.

(ii) <u>Propanone and propanol:</u>Propanone gives yellow ppt of Iodoform (CHI_3)on addition of NaOH / I_2 whereas propanol does not give this test. Or / Propanol gives brisk effervesence on adding a piece of Sodium metal whereas Propanone does not give this test.

28.

(a)(i)

Differential rate equation: Rate = $\frac{-d[R]}{dt} = K[A]^2[B]$

(ii) On increasing the concentration of A three times as 3A:

Rate'= $= K[3A]^2[B] = 9K[A]^2[B] = 9K[A]^2[B] = 9(\text{Rate})$

I.e. New rate is 9 times the initial rate.

(iii) On increasing the concentration of A and B as 2A and 2B:

Rate"= $K[2A]^2[2B] = K(4 \times 2)[A]^2[B] = 8k[A]^2[B] = 8(\text{Rate})$, i.e 8 times the initial rate.

(b)

$$\begin{array}{lll} & A \rightarrow P & \\ t = 0 & a & 0 \\ t = t & (a = x) & x \end{array}$$

Now, it takes 40 min for 30% decomposition i.e. reactant left after 40 min is 70% of its initial concentration.

$$K = \frac{2.303}{t}\log\frac{a}{a-x}$$

$$K = \frac{2.303}{40}\log\frac{a}{(70/100)a} = \frac{2.303}{40}\log 1.428$$

$$\therefore K = 0.00891\,\text{min}^{-1}$$

$$\therefore t_{\frac{1}{2}} = \frac{0.693}{K} = \frac{0.693}{0.008913} = 77.78\,\text{min}$$

Or

(a) For a first order reaction

$$\begin{array}{lll} & A \rightarrow P & \\ t = 0 & a & 0 \\ t = t & (a = x) & x \end{array}$$

Case 1: If 't' is the time required for 99% completion then x = 99% of a

$$(a-x)=\frac{1}{100}\times a=\frac{a}{100}$$
$$t=\frac{2.303}{K}\log\frac{a}{a-x}=\frac{2.303}{K}\log\frac{a\times 100}{K}\log 10^2$$
$$\therefore\ t=2\left[\frac{2.303}{K}\right]$$

Case 2: If 't' is the time required for 90% of completion then x = 90% of a

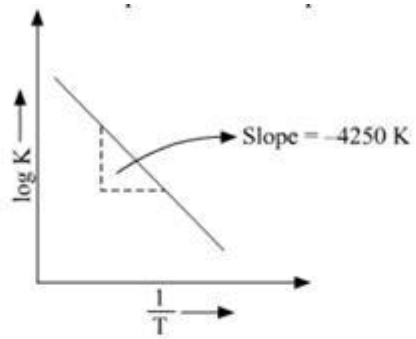
$$a-x=\frac{10}{100}a=\frac{a}{10}$$
$$t=\frac{2.303}{K}\log\frac{a}{a-x}=\frac{2.303}{K}\log\frac{a\times 10}{a}$$
$$\therefore\ t=\frac{2.303}{K}$$

Therefore, the time required for 99% completion of 1st order reaction is twice the time required for 90% completion.

(b) $\log k=\log A\ \frac{E_a}{2.303R}\left(\frac{1}{T}\right)$

E_a is Activation energy

The above equation is like y = mx + c where if we plot y v/s x we get a straight line with slope 'm' and intercept 'c'.



So, slope is equal to $=\frac{-E_a}{2.303R}$

$$\Rightarrow\frac{-E_a}{2.303R}=-4250K\Rightarrow E_a=4250\times 2.303\times 8.314=81,375.3535\ \text{J mol}^{-1}$$
$$\Rightarrow E_a=81.3753\ \text{KJ mol}^{-1}$$

29.

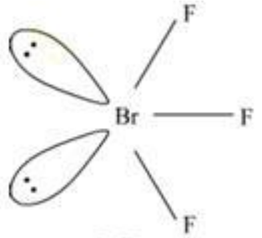
(a)

(i) F atom is small in size and due to this the electron-electron repulsions between the lone pairs of F-F are very large. Thus, the bond dissociation energy of F_2 is lower than that of Cl_2.

(ii) PH_3 has lower boiling point than NH_3 because NH_3 molecule possess intermolecular hydrogen bonding which binds its molecules strongly whereas PH_3 has weaker Vander Waal's forces. Thus, PH_3 has lower boiling point than NH_3.

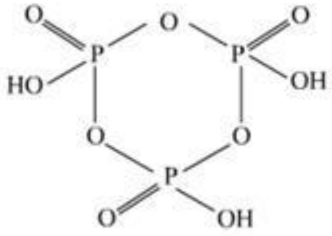
(b)The structures of following molecules are as follows:

(i)BrF_3, Bent T-shape



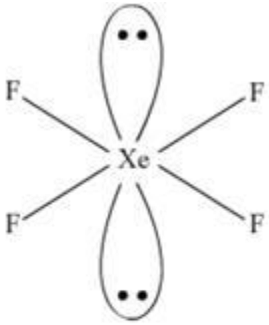
BrF_3

(ii) $(HPO_3)_3$, cyclic structure



$(HPO_3)_3$

(iii) XeF_4, Square planar



Or

(a)

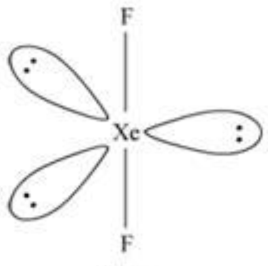
(i) Helium mixed with oxygen under pressure is given to sea-divers for respiration. Air is not given to sea-divers because nitrogen present in air being soluble in blood will give a painful sensation called bends by bubbling out blood on moving from high pressure(in deep sea) to the low atmospheric pressure.

(ii) Fluorine being the most electronegative atom does not exhibit positive oxidation state because the electrons in fluorine are strongly attracted by the nuclear charge because of small size of fluorine atom and therefore, removal of an electron is not possible.

(iii) Sulphur shows catenation behavior more than that of oxygen because the oxygen atom is smaller in size as compared to sulphur, the O-O bonds in oxygen experiences repulsions due to the lone pairs present on oxygen atom and therefore, are weaker as compared to the S-S bonds.

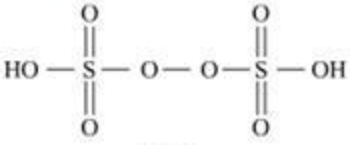
(b) The structure of following molecules are as follows:

(i)XeF_2, Linear



XeF_2

(ii) $H_2S_2O_8$



$$HO-\overset{\overset{\displaystyle O}{\|}}{\underset{\underset{\displaystyle O}{\|}}{S}}-O-O-\overset{\overset{\displaystyle O}{\|}}{\underset{\underset{\displaystyle O}{\|}}{S}}-OH$$

$H_2S_2O_8$