CBSE Examination Paper, 2020
Delhi [Set (I, II, III)]

Time Allowed : 3 hours] [*Maximum Marks* : 70

General Instructions:

(*i*) *Question paper comprises four sections – A, B, C and D.*

(*ii*) *There are 37 questions in the questions paper.* ***All*** *questions are compulsory.*

(*iii*) ***Section–A*** *: Question no.* ***1*** *to* ***20*** *are very short answer type questions carrying* ***one*** *mark each. Answer these questions in one word or one sentence.*

(*iv*) ***Section–B*** *: Question no.* ***21*** *to* ***27*** *are short answer type questions carrying* ***two*** *marks each.*

(*v*) ***Section–C*** *: Question no.* ***28*** *to* ***34*** *are long answer type-I questions carrying* ***three*** *marks each.*

(*vi*) ***Section–D*** *: Question no.* ***35*** *to* ***37*** *are long answer type-II questions carrying* ***five*** *marks each.*

(*vii*) *There is NO overall choice in the question paper. However, an internal choice has been provided in* ***2*** *questions of* ***two*** *marks, 2 questions of* ***three*** *marks and all the* ***3*** *questions of* ***five*** *marks. You have to at****tempt only one of the choices*** *in such questions.*

(*viii*) *However, separate instructions are given with each section and question, wherever necessary.*

(*ix*) *Use of calculators and long tables is NOT permitted.*

Set-I

SECTION — A

Read the given passage and answer the questions 1 to 5 that follow:

The halogens have the smallest atomic radii in their respective periods. The atomic radius of fluorine is extremely small. All halogens exhibit – 1 oxidation state. They are strong oxidising agents and have maximum negative electron gain enthalpy. Among halogens, fluorine shows anomalous behaviour in many properties. For example, electro negativity and ionisation enthalpy are higher for fluorine than expected whereas bond dissociation enthalpy, m.p. and b.p. and electron gain enthalpy are quite lower than expected. Halogens react with hydrogen to give hydrogen halides (HX) and combine amongst themselves to form a number of compounds of the type XX′, XX'_3, XX'_5 and XX'_7 called inter-halogens.

1. Why halogens have maximum negative electron gain enthalpy?

Ans. It is because halogens are smallest in size and have high effective nuclear charge. They attain stable electronic configuration on gaining one electron.

2. Why fluorine shows anomalous behaviour as compared to other halogens?

Ans. It is because 'F' has smallest size, highest electronegativity, absence of *d*-orbitals and low bond dissociation enthalpy of F—F bond.

3. Arrange the hydrogen halides (HF to HI) in the decreasing order of their reducing character.

Ans. HI > HBr > HCl > HF is decreasing order of reducing power.

4. Why fluorine is a stronger oxidizing agent than chlorine?

Ans. It is due to low bond dissociation energy/enthalpy and high hydration enthalpy of F^- ion.

5. What are the sizes of X and X′ in the interhalogen compounds?

Ans. X is bigger in size than X′ in interhalogen compounds.

6. Name the cell used in hearing aids and watches.

Ans. Mercury cell.

7. How much charge in terms of Faraday is required to reduce one mol of MnO_4^- to Mn^{2+}?

Ans. 5 Faraday.

8. Write the slope value obtained in the plot of log $[R_0]$ / [R] Vs time for a first order reaction.

Ans. $\text{Slope} = \dfrac{k}{2.303}$

9. Name the sweetening agent used in the cooking of sweets for a diabetic patient.

Ans. Sucralose/Sachharine/Alitame (except aspartame)

10. Name the polymer which is used for making electrical switches and combs.

Ans. Bakelite

Question 11 to 15 are multiple choice.

11. In the Mond's process the gas used for the refining of a metal is

(*a*) H_2 **(*b*) CO_2**

(*c*) CO **(*d*) N_2**

Ans. (*c*) $\underset{\text{(Impure)}}{Ni} + 4CO \longrightarrow Ni(CO)_4 \xrightarrow{\text{heat}} \underset{\text{(Pure)}}{Ni} + 4CO$

12. The conversion of an alkyl halide into an alcohol by aqueous NaOH is classified as

(*a*) a dehydrohalogenation reaction **(*b*) a substitution reaction**

(*c*) an addition reaction **(*d*) a dehydration reaction**

Ans. (*b*) $RX + NaOH(aq) \longrightarrow ROH + NaX$ (substitution reaction)

13. CH_3CONH_2 on reaction with NaOH and Br_2 in alcoholic medium gives

(*a*) $CH_3CH_2NH_2$ **(*b*) CH_3CH_2Br**

(*c*) CH_3NH_2 **(*d*) CH_3COONa**

Ans. (*c*) $CH_3CONH_2 + Br_2 + 4NaOH \longrightarrow CH_3NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$

14. The oxidation state of Ni in $[Ni(CO)_4]$ is

(*a*) 0 **(*b*) 2**

(*c*) 3 **(*d*) 4**

Ans. (*a*) $[Ni(CO)_4] \quad x + 0 = 0 \quad \Rightarrow \quad x = 0$

15. Amino acids are

(*a*) acidic **(*b*) basic**

(*c*) amphoteric **(*d*) neutral**

Ans. (*c*) Amino acids are amphoteric due to presence of acidic —COOH (carboxylic) and basic —NH_2 (amino) group.

Note: In this question all four options are correct. [1 Mark is to be awarded for any option.]

Question 16 to 20.

(A) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).

(C) Assertion (A) is correct, but Reason (R) is wrong statement.

(D) Assertion (A) is wrong, but Reason (R) is correct statement.

16. Assertion (A): Conductivity of an electrolyte increases with decrease in concentration.

Reason (R): Number of ions per unit volume decreases on dilution.

Ans. (D) 'A' is wrong but 'R' is true. Conductivity decreases with decrease in concentration.

17. Assertion (A): The C—O—C bond angle in ethers is slightly less than tetrahedral angle.

Reason (R): Due to the repulsive interaction between the two alkyl groups in ethers.

Ans. (D) 'A' is wrong but 'R' is true. The C—O—C bond angle in ethers is slightly more than tetrahedral angle (110°).

18. Assertion (A): Low spin tetrahedral complexes are rarely observed.

Reason (R): Crystal field splitting energy is less than pairing energy for tetrahedral complexes.

Ans. (A) Both 'A' and 'R' are correct and 'R' is correct reason of 'A'.

19. Assertion (A): Elevation in boiling point is a colligative property.

Reason (R): Elevation in boiling point is directly proportional to molarity.

Ans. (C) 'A' is correct but 'R' is wrong because $\Delta T_b \propto m$ (molality).

20. Assertion (A): Oxidation of ketones is easier than aldehydes.

Reason (R): C—C bond of ketones is stronger than C—H bond of aldehydes. 20×1=20

Ans. (D) 'A' is wrong but 'R' is true because aldehydes can be oxidised more easily than ketones.

SECTION – B

21. State Raoult's law for a solution containing volatile components. What is the similarity between Raoult's law and Henry's law? 2

Ans. Raoult's law: Both law state that partial vapour pressure of each component is directly proportional to its mole fraction when both solute and solvent are volatile.

$$\left.\begin{aligned} p_A \propto x_A \;&\Rightarrow\; p_A = p_A^{\circ} x_A \\ \text{and}\quad p_B \propto x_B \;&\Rightarrow\; p_B = p_B^{\circ} x_B \end{aligned}\right] \text{Raoult's law}$$

$$p_{gas} = K_H \times x_{gas} \text{ Henry's law}$$

22. Write the role of

(*a*) Dilute NaCN in the extraction of Gold.

(b) CO in the extraction of Iron. **1+1=2**

Or

How is leaching carried out in the case of low grade copper ores? Name the method used for refining of copper metal. **2**

Ans. (*a*) $4Au + 8NaCN + 2H_2O + O_2 \longrightarrow 4Na[Au(CN)_2] + 4NaOH$

NaCN acts as leaching agent. NaCN forms a complex with impure Gold, sodium dicyanido aurate (I) while Zn acts as a reducing agent.

$$2Na[Au(CN)_2] + Zn \longrightarrow Na_2[Zn(CN)_4] + 2Au$$

(*b*) Carbon monoxide(CO) is better reducing agent at lower temperature range,

$$Fe_2O_3 + CO \longrightarrow 2FeO + CO_2$$

$$FeO + CO \longrightarrow Fe + CO_2$$

or $$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$$

Or

Extraction of Copper from low grade ores and scraps: It is extracted by hydrometallurgy. It is carried out in two steps:

- **Leaching:** Low grade copper ores and scraps are leached by using acid or bacteria.
- **Reduction:** The solution containing copper ions is treated with H_2.

$$Cu^{2+}(aq) + H_2(g) \longrightarrow Cu(s) + 2H^+(aq)$$

It is called hydrometallurgy.

Copper is refined by electrolytic refining.

23. Define adsorption with an example. What is the role of adsorption in heterogeneous catalysis? **2**

Or

Define Brownian movement. What is the cause of Brownian movement in colloidal particles? How is it responsible for the stability of Colloidal Sol? **2**

Ans. **Adsorption:** When concentration of solute is different at surface than bulk, it is called adsorption, e.g. O_2, H_2, CO, Cl_2, NH_3 or SO_2 get adsorbed on the surface of charcoal.

Adsorption of reactants on solid surface of catalyst increases the rate of reaction due to more probability of collisions and effective collision.

or

Adsorption is the accumulation of molecular species at the surface rather than the bulk of the solid or liquid e.g.,gases get adsorbed on the surface of activated charcoal.

Or

Brownian movement. The zig-zag motion of colloidal particles due to collision between particles of dispersion medium among themselves and with particles of dispersion medium is called Brownian movement. It leads to stability of colloidal solution.

or

Brownian movement is caused by unbalanced bombardment of particles by the molecules of dispersion medium.

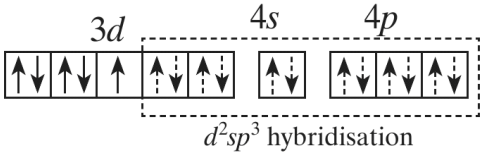
The Brownian movement has stirring effect which does not permit colloidal particle to settle down and thus, it is responsible for the stability of colloidal solution.

24. (*a*) **Write the IUPAC name and hybridisation of the complex $[Fe(CN)_6]^{3-}$. (Given: Atomic number of Fe = 26)**

(*b*) **What is the difference between an ambidentate ligand and a chelating ligand? 1+1=2**

Ans. (*a*) Hexacyanido ferrate (III) or Hexacyano ferrate (III)

CN^- is a strong field ligand, therefore, it causes pairing of electrons, forms low spin.

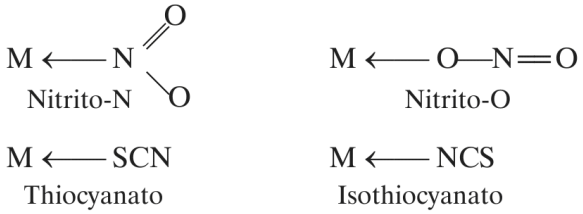


$[Fe(CN)_6]^{3-}$ has d^2sp^3 hybridization, weakly paramagnetic due to presence of one unpaired electron, therefore, low spin complex.

(*b*) Chelating ligands form cyclic complex where as ambidentate ligands form non-cyclic ligands.

or

Ambidentate ligand: Ligands which can ligate (link) through two different atoms present in it are called *ambidentate ligands*, e.g. NO_2^-, SCN^-, CNO^- and CN^-. NO_2^- can link through 'N' as well as oxygen while SCN^- can link through 'S' as well as 'N' atoms.



Chelating or Polydentate ligand: The ligand which can form two or more σ bond with central metal atom or ion, e.g., $\begin{matrix} COO^- \\ | \\ COO^- \end{matrix}$

Polydentate ligand are also called chelating agents.

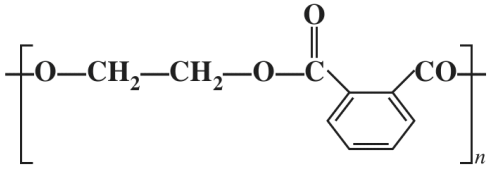
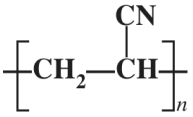
25. How do antiseptics differ from disinfectants? Name a substance which can be used as a disinfectant as well as an antiseptic. 2

Ans. Antiseptics are applied to living tissue where as disinfectants are applied to inanimate / non-living objects. 1 to 2 percent solution of phenol is used as disinfectant.

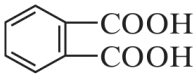
or

Antiseptics do not harm living tissue where as disinfectants are harmful for living tissues. 0.2% solution of phenol is antiseptic, where as 2% solution of phenol is disinfectant.

26. Identify the monomers in the following polymers:

(*i*)  (*ii*)  **1+1=2**

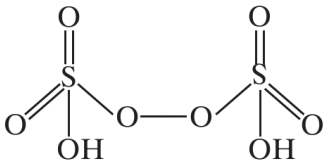
Ans. (*i*) Ethane 1,2 - diol and Benzene 1,2-dicarboxylic acid.

$CH_2OH—CH_2OH$ and 

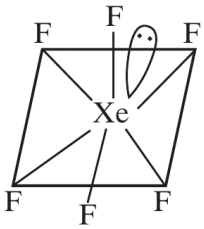
(*ii*) $CH_2=\underset{\displaystyle CN}{\underset{|}{C}}H$ is monomer. (Acrylonitrile/Propene nitrile)

27. Draw the structures of the following:

(*i*) **$H_2S_2O_8$** (*ii*) **XeF_6** **1+1=2**

Ans. (*i*) 

$(H_2S_2O_8)$

(*ii*) 

(XeF_6)

SECTION – C

28. A 0.01 m aqueous solution of $AlCl_3$ freezes at – 0.068 °C. Calculate the percentage of dissociation.

[Given: K_f for Water = 1.86 K kg mol^{-1}] **3**

Ans. $m = 0.01$ m, $\Delta T_f = 0°C - (-0.068°C) = +0.068°C$

$$\Delta T_f = i\,K_f \times m \qquad \text{[where '}i\text{' is van't Hoff factor]}$$

$$0.068 = i \times 1.86 \times 0.01$$

$$i = \frac{0.068}{.0186} = 3.656$$

$AlCl_3(aq) \longrightarrow Al^{3+}(aq) + 3Cl^-$ $(n = 4)$

$$\alpha = \frac{i-1}{n-1} = \frac{3.656-1}{4-1} = \frac{2.656}{3} = 0.885$$

$$\alpha = 0.885 \times 100 = 88.5\%$$

The percentage dissociation of $AlCl_3$ is 88.5%.

29. When a steady current of 2A was passed through two electrolytic cells A and B containing electrolytes $ZnSO_4$ and $CuSO_4$ connected in series, 2 g of Cu were deposited at the cathode of cell B. How long did the current flow? What mass of Zn was deposited at cathode of cell A? **3**

[Atomic mass : Cu = 63.5 g mol^{-1}, Zn = 65 g mol^{-1}, 1F = 96500 C mol^{-1}]

Ans. I = 2A, W_{Cu} = 2g, t = ?, W_{Zn} = ?

$$m = Z \times I \times t$$

$$2 = \frac{63.5}{2 \times 96500} \times 2 \times t \qquad \left[Z = \frac{\text{Atomic mass}}{\text{Valency} \times 96500}\right]$$

$$t = \frac{2 \times 2 \times 96500}{2 \times 63.5} = \frac{193000}{63.5} = 3039.37 = 3039.4 \text{ s}$$

$$t = \frac{3039.4}{60} = 50.656 \text{ min}$$

$$\frac{W_{Cu}}{E_{Cu}} = \frac{W_{Zn}}{E_{Zn}}$$

$$E_{Cu} = \frac{63.5}{2} = \frac{\text{Atomic mass}}{\text{Valency}}$$

$$E_{Zn} = \frac{65}{2} = \frac{\text{Atomic mass}}{\text{Valency}}$$

$$\frac{2}{\frac{63.5}{2}} = \frac{W_{Zn}}{\frac{65}{2}}$$

$$W_{Zn} = \frac{2 \times 65}{63.5} = \frac{130}{63.5} = 2.047 \text{ g} = 2.05 \text{ g}$$

30. Differentiate between following:

(*i*) Amylose and Amylopectin

(*ii*) Globular protein and Fibrous protein

(*iii*) Nucleotide and Nucleoside **1+1+1=3**

Ans. (*i*) **Amylose:** It is a linear chain polymer of α-glucose, water soluble component of starch which constitute 15-20% of starch. It has $C_1 - C_4$ linkages.

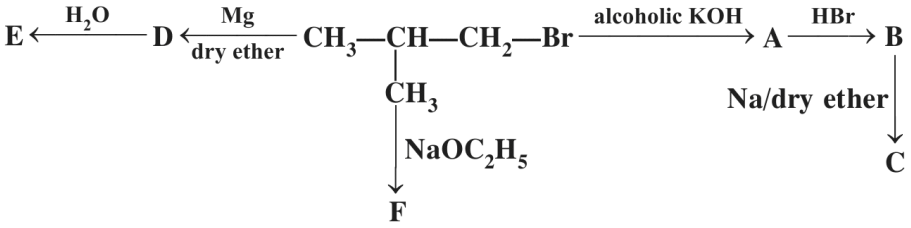
Amylopectin: It is branched chain polymer of α-glucose, water insoluble component, form 80-85% of starch. It has $C_1 - C_4$ and $C_1 - C_6$ linkages.

(*ii*) **Fibrous proteins:** Thread like structure, insoluble in water, e.g. keratin (hair, wool, silk), myosin (muscles) etc, have β-pleated structure.

Globular proteins: Chains of polypeptidic coil around (α-helix), spherical shape, soluble in water, e.g. insulin, albumin.

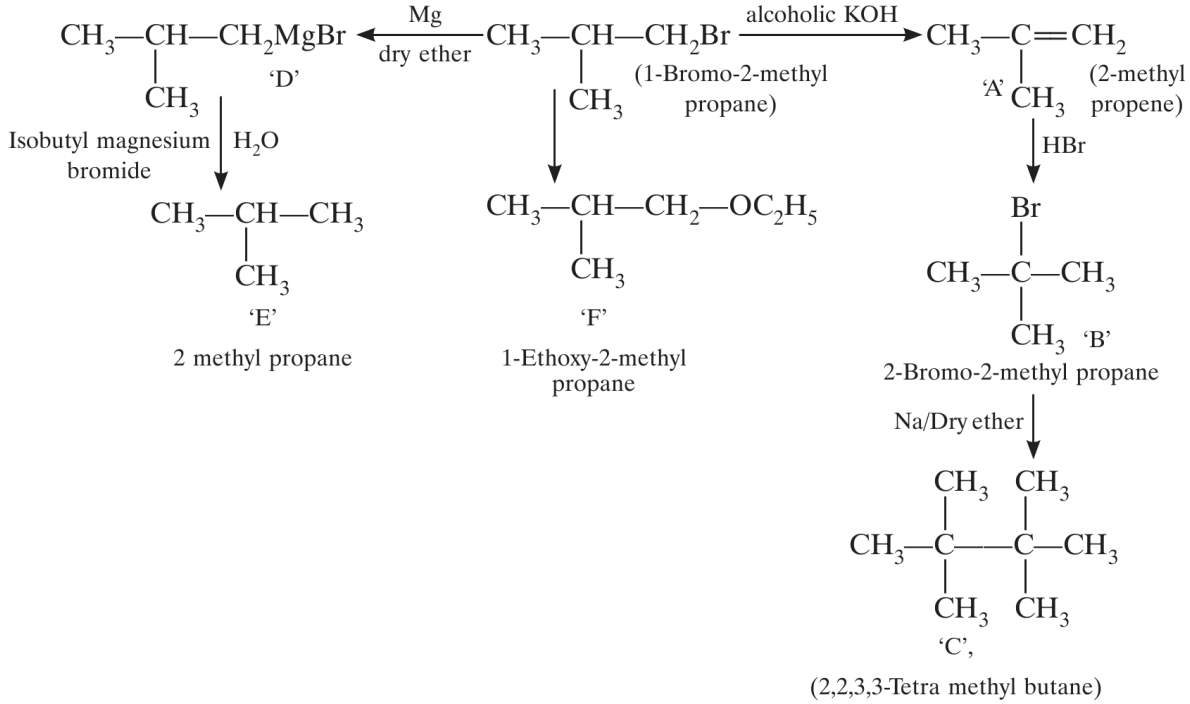
(*iii*) Nucleoside contains ribose or deoxyribose sugar and heterocyclic base, e.g. adenosine, whereas nucleotides contain phosphoric acid residue along with heterocyclic base and pentose sugar, e.g. adenosine triphosphate (ATP).

31. Identify A, B, C, D, E and F in the following:



6×½=3

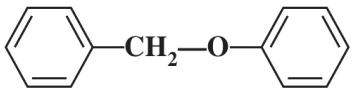
Ans.



32. Give the structures of final products expected from the following reactions:

(*i*) Hydroboration of propene followed by oxidation with H_2O_2 in alkaline medium.

(*ii*) Dehydration of $(CH_3)_3C—OH$ by heating it with 20% H_3PO_4 at 358 K.

(*iii*) Heating of  **with HI.** **3×1=3**

Or

How can you convert the following?

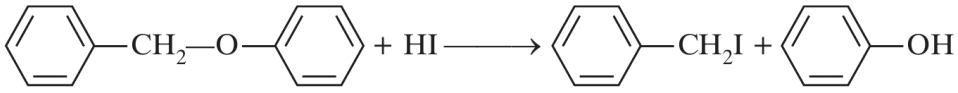
(*i*) Phenol to *o*-hydroxybenzaldehyde

(*ii*) Methanal to ethanol

(*iii*) Phenol to phenyl ethanoate **1+1+1=3**

Ans. (*i*) $CH_3—CH=CH_2 \xrightarrow[(ii)\ H_2O_2/OH^-]{(i)\ B_2H_6} CH_3—CH_2—CH_2—OH$

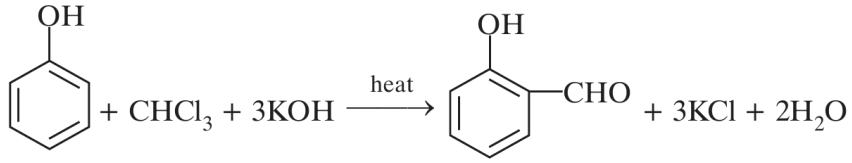
(*ii*) $CH_3—\underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}}—CH_3 \xrightarrow[358\ K]{20\%\ H_3PO_4} CH_3—\overset{\overset{CH_3}{|}}{C}=CH_2 + H_2O$

(*iii*) 

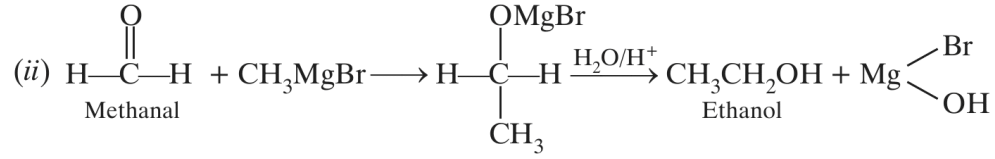
Or

(*i*) **Reimer-Tiemann reaction:**

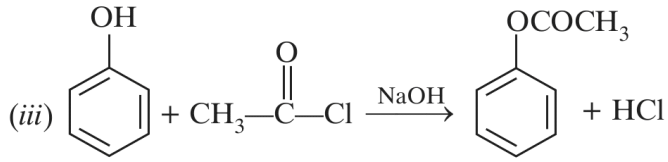
When phenol is heated with $CHCl_3$ and KOH, salicylaldehyde is formed.



Phenol Salicyldehyde

(*ii*) 

Methanal Ethanol

(*iii*) 

Phenol Phenyl ethanoate

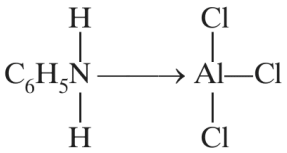
33. Give reasons:

(*i*) **Aniline does not undergo Friedal-Crafts reaction.**

(*ii*) **Aromatic primary amines cannot be prepared by Gabriel's phthalimide synthesis.**

(*iii*) **Aliphatic amines are stronger bases than ammonia.** **3×1=3**

Ans. (*i*) It is because aniline is basic which can form adduct (Salt) with $AlCl_3$ (Lewis acid).



(*ii*) It is because aryl halides do not undergo nucleophilic substitution reaction easily.

(*iii*) It is because ethyl group is electron releasing and increases electron density on 'N' of $C_2H_5NH_2$ than NH_3.

or

It is because alkyl groups are electron releasing. In alkyl amines, they will increase electron density on 'N', therefore, they are more basic than NH_3.

34. Write three differences between lyophobic sol and lyophilic sol. **3**

Or

Define the following terms:

(*i*) Protective colloid

(*ii*) Zeta potential

(*iii*) Emulsifying agent **1+1+1=3**

Ans. Difference between lyophilic sols and lyophobic sols:

Lyophilic sols	Lyophobic sols
(*i*) There is force of attraction between dispersed phase and dispersion medium.	(*i*) There is no affinity between dispersed phase and dispersion medium.
(*ii*) They are easily prepared by shaking dispersed phase with dispersion medium.	(*ii*) They are prepared by indirect methods, e.g. peptization hydrolysis, electro-dispersion, etc.
(*iii*) These are self-stabilized.	(*iii*) They need stabilizing agent.
(*iv*) These are reversible sols, e.g. gums, starch, albumin and other proteins in water.	(*iv*) These are irreversible sols, e.g. As_2S_3, sulphur, $Fe(OH)_3$ sol, gold sol, etc.

Or

Ans. (*i*) The lyophilic colloid which help in stability of lyophobic sol and prevents its coagulation e.g. Starch, gelatin.

(*ii*) Zeta potential (Electrokinetic Potential): The potential difference between the fixed layer and the diffused layer of colloidal solution having opposite charges is called zeta potential or electrokinetic potential.

(*iii*) **Emulsifying agents:** Those substances which stabilizes emulsion are called emulsifying agents. E.g. Soaps and detergents, bile juice etc.

SECTION – D

35. (*a*) Give reasons:

(*i*) Transition metals and their compounds show catalytic activities.

(*ii*) Separation of a mixture of Lanthanoid elements is difficult.

(*iii*) Zn, Cd and Hg are soft and have low melting point.

(*b*) Write the preparation of the following:

(*i*) $Na_2Cr_2O_7$ from Na_2CrO_4

(*ii*) K_2MnO_4 from MnO_2 **3+2=5**

Or

(*a*) Account for the following:

(*i*) Ti^{3+} is coloured whereas Sc^{3+} is colourless in aqueous solution.

(*ii*) Cr^{2+} is a strong reducing agent.

(*b*) Write two similarities between chemistry of lanthanoids and actinoids.

(*c*) Complete the following ionic equation: **2+2+1=5**

$3MnO_4^{2-} + 4H^+ \longrightarrow$

Ans. (*a*) (*i*) It is because they show variable oxidation states and have vacant *d*-orbitals forming unstable intermediates which readily change into products.

(*ii*) It is due to similar ionic size, similar properties due to lanthanoid contraction, their separation is difficult.

(*iii*) It is because they have weak metallic bonds due to absence of unpaired electrons.

(*b*) (*i*) $2Na_2CrO_4 + H_2SO_4\,(conc.) \longrightarrow Na_2Cr_2O_7 + Na_2SO_4 + H_2O$

(*ii*) $2MnO_2 + 4KOH + O_2 \longrightarrow 2K_2MnO_4 + 2H_2O$

[Balancing may be ignored while awarding marks.]

Or

(*a*) (*i*) Ti^{3+} has one unpaired electron and undergoes *d-d* transitions by absorbing visible light and radiates violet colour, Sc^{3+} does not have unpaired electrons.

(*ii*) Cr^{2+} is stronger reducing agent because it will get oxidised to Cr^{3+} which has half-filled t_{2g}^3 which is more stable than $3d^5$ in Fe^{3+}.

(*b*) **Similarity:** (*i*) Both lanthanoids and actinoids show contraction.

(*ii*) The most characteristic oxidation state of both lanthanoid and actinoid is +3.

(*iii*) Both show variable oxidation state.

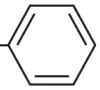
(*iv*) Both show *f-f* transition.

(*v*) electrons of *f*-orbitals in both have poor shielding effect. (*Any two*)

(*c*) $3MnO_4^{2-} + 4H^+ \longrightarrow 3MnO_4^- + MnO_2 + 2H_2O$

36. (*a*) Write the products formed when benzaldehyde reacts with the following reagents:

(*i*) CH_3CHO in presence of dilute NaOH

(*ii*) $H_2N—NH$ 

(*iii*) Conc. NaOH

(*b*) Distinguish between following:

(*i*) $CH_3—CH=CH—CO—CH_3$ and $CH_3—CH_2—CO—CH=CH_2$

(*ii*) Benzaldehyde and Benzoic acid. **3+(1+1)=5**

Or

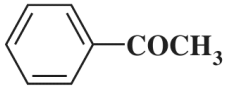
(*a*) Write the final products in the following:

(*i*) $CH_3-C(=O)-CH_3 \xrightarrow[\text{Conc. HCl}]{\text{Zn/Hg}}$

(*ii*)  $\xrightarrow[\Delta]{\text{NaOH/CaO}}$

(*iii*) $CH_2=CH-CH_2-CN \xrightarrow[(b)\ H_3O^+]{(a)\ \text{DIBAL—H}}$

(*b*) Arrange the following in the increasing order of their reactivity towards nucleophilic addition reaction:

CH_3COCH_3, HCHO, CH_3CHO, 

(*c*) Draw the structure of 2, 4 DNP derivative of acetaldehyde. **3+1+1=5**

Ans. (*a*) (*i*) $C_6H_5-\overset{O}{\overset{\|}{C}}-H + CH_3-\overset{O}{\overset{\|}{C}}-H \xrightarrow{NaOH} C_6H_5-\underset{OH}{CH}-CH_2-\overset{O}{\overset{\|}{C}}-H$

3-hydroxy -3-phenyl propanal.

(*ii*) $C_6H_5-\overset{H}{\underset{|}{C}}=O + H_2N-NH-C_6H_5 \longrightarrow C_6H_5CH=N-NH-C_6H_5$

Phenyl hydrazone of Benzaldehyde

(*iii*) $2C_6H_5-\overset{O}{\overset{\|}{C}}-H \xrightarrow{\text{Conc. NaOH}} C_6H_5CH_2OH + C_6H_5COONa$

Benzyl alcohol Sodium benzoate

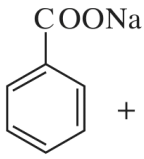
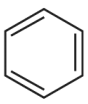
(*b*) (*i*) Add I_2 and NaOH. $CH_3-CH=CH-COCH_3$ will give yellow ppt of iodoform where as $CH_3-CH_2-CO-CH=CH_2$ will not.

(*ii*) Add $NaHCO_3$ to each. Benzaldehyde will not react, Benzoic acid will give brisk effervescence due to CO_2.

Or

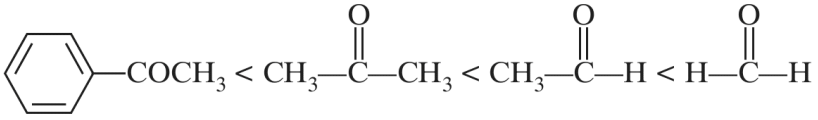
(*a*) (*i*) $CH_3-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[\text{conc. HCl}]{\text{Zn (Hg)}} CH_3-CH_2-CH_3 + H_2O$

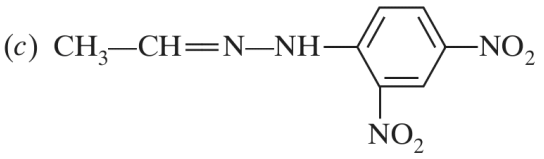
Propanone Propane

(*ii*)  $+ NaOH(CaO) \xrightarrow{\Delta}$  $+ Na_2CO_3$

Sodium benzoate Benzene

(*iii*) $CH_2=CH-CH_2-CN \xrightarrow[(b)\ H_3O^+]{(a)\ \text{DIBAL-H}} CH_2=CH-CH_2-\overset{O}{\overset{\|}{C}}-H$

(*b*)  $< CH_3-\overset{O}{\overset{\|}{C}}-CH_3 < CH_3-\overset{O}{\overset{\|}{C}}-H < H-\overset{O}{\overset{\|}{C}}-H$

(*c*) 

37. (*a*) **A first order reaction is 25% complete in 40 minutes. Calculate the value of rate constant. In what time will the reaction be 80% completed?** **3+2=5**

(*b*) **Define order of reaction. Write the condition under which a bimolecular reaction follows first order kinetics.**

Or

(*a*) **A first order reaction is 50% complete in 30 minutes at 300 K and in 10 minutes at 320 K. Calculate activation energy (E_a) for the reaction. (R = 8.314J K^{-1} mol^{-1})**

(*b*) **Write the two conditions for collisions to be effective collisions.**

(*c*) **How order of reaction and molecularity differ towards a complex reaction?**

[Given: log 2 = 0.3010, log 3 = 0.4771, log 4 = 0.6021, log 5 = 0.6991] **3+1+1=5**

Ans. (*a*) $k = \dfrac{2.303}{t}\log\dfrac{[R]_0}{[R]}$

$k = \dfrac{2.303}{40\text{ min}}\log\dfrac{[R]_0}{3[R]_0/4}$ $\quad [\text{R} = [R]_0 - [R]_0/4]$

$k = \dfrac{2.303}{40}(\log 4 - \log 3) = \dfrac{2.303}{40}(0.6021 - 0.4771)$ $\quad [\text{R}]_0 - [R]_0/4$

$k = \dfrac{2.303}{40} \times 0.1250 = 7.197 \times 10^{-3}\ \text{min}^{-1}$

$t_{80\%} = \dfrac{2.303}{k}\log\dfrac{[R]_0}{[R]}$

$t_{80\%} = \dfrac{2.303}{2.303} \times \dfrac{40}{0.125} \times \log\dfrac{[R]_0}{\frac{20}{100}[R]_0}$ $\quad \left[\because [R] = [R]_0 - \dfrac{80}{100}[R_0]\right]$

$t_{80\%} = 320 \times \log 5$

$= 320 \times 0.6991$

$= 223.7\ \text{min}$

(*b*) Order of reaction is defined as sum of powers to which conc. terms are raised in rate law or rate equation. If one of the reactants is present in large amount (excess) biomolecular reaction follows first order kinetics.

Or

(*a*)
$$k_1 = \frac{0.693}{t_{1/2}} = \frac{0.693}{30 \text{ min}} \text{ at } T_1 = 300 \text{ K}$$

$$k_2 = \frac{0.693}{t_{1/2}} = \frac{0.693}{10 \text{ min}} \text{ at } T_2 = 320 \text{ K}$$

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303\,R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\log \frac{0.693}{10} \times \frac{30}{0.693} = \frac{E_a}{2.303 \times 8.314}\left(\frac{1}{300} - \frac{1}{320}\right)$$

$$E_a = \frac{19.147 \times 300 \times 320}{20} \log 3$$

$$E_a = 19.147 \times 4800 \times 0.4771 \text{ J}$$

$$E_a = 43847.16 \text{ J mol}^{-1}$$

$$E_a = 43.848 \text{ kJ mol}^{-1}$$

(*b*) (*i*) Molecule must have activation energy.

(*ii*) These molecules must collide in proper orientation.

(*c*) In complex reaction, slowest step is the rate determining step which determines order of reaction.

Each step of complex reaction is called elementary reaction which has its own molecularly.

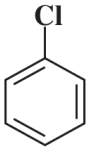
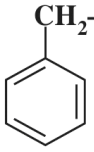
or

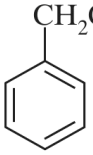
For a complex reaction, order of reaction is applicable while molecularity has no meaning.

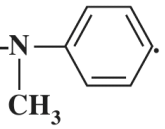
Set-II (Uncommon Questions to Set-I)

SECTION – A

Question 6 to 10 are one word answers:

6. Out of  **and**  **, which will undergo S_N1 reaction faster with OH^-?**

Ans.  will undergo S_N1 reaction faster with OH^-.

7. Write the IUPAC name of  .

Ans. N, N-Dimethyl benzenamine or N, N-Dimethyl aniline.

8. What type of linkage is present in polysaccharides?

Ans. Glycosidic linkage.

9. Name an artificial sweetener whose use is limited to cold drinks.

Ans. Aspartame.

10. Name the polymer which is used for making non-stick utensils.

Ans. Teflon/PTFE (poly tetrafluoro ethylene)

Question 11 to 15 are multiple choice questions.

11. Kohlrausch given the following relation for strong electrolytes:

$\Lambda = \Lambda_0 - A\sqrt{C}$

Which of the following equality holds?

(a) $\Lambda = \Lambda_0$ **as** $C \longrightarrow \sqrt{A}$ **(b)** $\Lambda = \Lambda_0$ **as** $C \longrightarrow \infty$

(c) $\Lambda = \Lambda_0$ **as** $C \longrightarrow 0$ **(d)** $\Lambda = \Lambda_0$ **as** $C \longrightarrow 1$

Ans. (c) $\Lambda = \Lambda_0$ as $C \longrightarrow 0$

12. In an electrochemical process, a salt bridge is used

(a) as a reducing agent.

(b) as an oxidizing agent.

(c) to complete the circuit so that current can flow.

(d) None of these

Ans. (c) In an electrochemical process, a salt bridge is used to complete the circuit so that current can flow.

13. In a chemical reaction X $\longrightarrow$ Y, it is found that the rate of reaction doubles when the concentration of X is increased four times. The order of the reaction with respect to X is

(a) 1 **(b) 0** **(c) 2** **(d) 1/2**

Ans. (d) 1/2

14. Which of the following will give a white precipitate upon reacting with $AgNO_3$?

(a) $K_2[Pt(en)_2Cl_2]$ **(b)** $[Co(NH_3)_3Cl_3]$ **(c)** $[Cr(H_2O)_6]Cl_3$ **(d)** $[Fe(H_2O)_3Cl_3]$

Ans. (c) $[Cr(H_2O)_6]\ Cl_3$

15. Copper matte contains

(a) Cu_2S, Cu_2O **and silica** **(b)** Cu_2S, **CuO and silica**

(c) Cu_2S, **FeO and silica** **(d)** Cu_2S, **FeS and silica**

Ans. (d) Copper matte contains Cu_2S, FeS and silica.

Questions 16 and 18

(A) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).

(C) Assertion (A) is correct, but Reason (R) is wrong statement.

(D) Assertion (A) is wrong, but Reason (R) is correct statement.

16. Assertion (A): 0.1 M solution of KCl has greater osmotic pressure than 0.1 M solution of glucose at same temperature.

Reason (R): In solution, KCl dissociates to produce more number of particles.

Ans. (A) Both 'A' and 'R' are correct statements and 'R' is correct explanation of 'A'.

18. Assertion (A): Ortho and para-nitrophenols can be separated by steam distillation.

Reason (R): Ortho isomer associates through intermolecular hydrogen bonding while Para isomer associates through intramolecular hydrogen bonding.

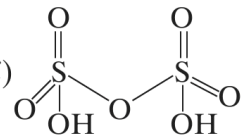
Ans. (C) 'A' is true statement 'R' is wrong statement.

SECTION – B

23. Draw the structures of the following:

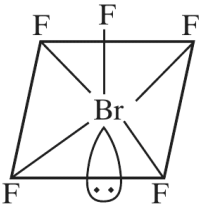
(*i*) $H_2S_2O_7$ **(*ii*) BrF_5** **2**

Ans. (*i*)



$(H_2S_2O_7)$

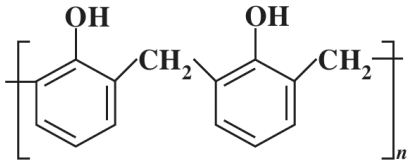
(*ii*)



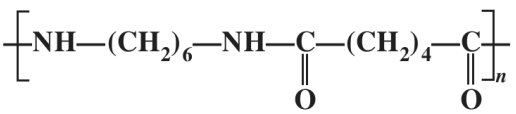
Square pyramidal

25. Identify the monomers in the following polymers:

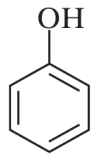
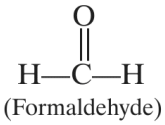
(*i*)



(*ii*)



2

Ans. (*i*)  and 

(Phenol) (Formaldehyde)

(*ii*) $H_2N—(CH_2)_6—NH_2$ and $HO—C(=O)—(CH_2)_4—C(=O)—OH$

Hexamethylene diamine (Adipic acid)

26. Discuss the nature of bonding in metal carbonyls. **2**

Ans. It involves both σ bond as well as π-bond. σ bond is formed by donation of lone pair of electron to the vacant *d*-orbitals of transition metals.

π-bond is formed by back donation of pair of electrons from transition metal to antibonding molecular orbital of CO.

It makes bond between metal and CO very strong.

[**Note:** Give 2 marks for attempting the question.]

SECTION – C

30. Define the following terms with a suitable example in each:

(*a*) Polysaccharides

(*b*) Denatured protein

(*c*) Fibrous protein **1+1+1=3**

Ans. (*a*) Those carbohydrate which on hydrolysis give large number of monosaccharides are called polysaccharide e.g. starch, glycogen, cellulose (*Any one*)

(*b*) **Denaturation of proteins:** On heating or change in pH, hydrogen bonds are disturbed, globules unfold and helix get uncoiled and leads to loss of biological activity, e.g. coagulation of egg white, curdling of milk.

(*c*) **Fibrous proteins:** Thread like structure, insoluble in water, e.g. keratin (hair, wool, silk), myosin (muscles) etc, have β-pleated structure.

or

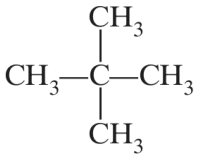
Fibrous proteins: When polypeptide chain run parallel and are held together by H-bonds and have disulphide bonds, the thread like structure is called fibrous proteins, e.g.,Keratin, Myosine.

Set-III (Uncommon Questions to Set-I and Set-II)

SECTION – A

Questions 6 to 10 are one word answers:

6. A hydrocarbon C_5H_{12} gives only one monochloride on photochemical chlorination. Identify the compound.

Ans.  (2,2-dimethyl propane)

7. Out of $(CH_3)_3N$ and $(CH_3)_2NH$, which one is more basic in aqueous solution?

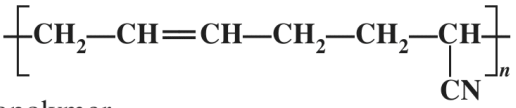
Ans. $(CH_3)_2NH$

8. Out of *Cis* – $[Pt(en)_2Cl_2]^{2+}$ and *Trans* – $[Pt(en_2)Cl_2]^{2+}$, Which one is optically active?

Ans. *Cis* $[Pt\ (en)_2Cl_2]^{2+}$

9. Name the method of refining used to obtain semiconductor of very high purity.

Ans. Zone refining

10. Is  **a homopolymer or copolymer?**

Ans. Copolymer

Question 11 to 15 are multiple choice questions:

11. The amount of electricity required to produce one mole of Zn from $ZnSO_4$ solution will be:

(*a*) **3F** (*b*) **2F**

(*c*) **1F** (*d*) **4F**

Ans. (*b*) 2F

12. Zinc is coated over iron to prevent rusting of iron because

(*a*) $E^\circ_{Zn^{2+}/Zn} = E^\circ_{Fe^{2+}/Fe}$ (*b*) $E^\circ_{Zn^{2+}/Zn} < E^\circ_{Fe^{2+}/Fe}$

(*c*) $E^\circ_{Zn^{2+}/Zn} > E^\circ_{Fe^{2+}/Fe}$ (*d*) **None of these**

Ans. (*b*) $E^\circ_{Zn^{2+}/Zn} < E^\circ_{Fe^{2+}/Fe}$

13. The unit of rate constant depends upon the

(*a*) **molecularity of the reaction.** (*b*) **activation energy of the reaction.**

(*c*) **order of the reaction.** (*d*) **temperature of the reaction.**

Ans. (*c*) Order of reaction

14. The formula of the complex triamminetri (nitrito-O) Cobalt (III) is

(*a*) $[Co(ONO)_3\ (NH_3)_3]$ (*b*) $[Co(NO_2)_3\ (NH_3)_3]$

(*c*) $[Co(ONO_2)_3\ (NH_3)_3]$ (*d*) $[Co(NO_2)\ (NH_3)_3]$

Ans. (*a*) $[Co(ONO)_3(NH_3)_3]$

15. Which of the following is a disaccharide?

(*a*) **Glucose** (*b*) **Starch**

(*c*) **Cellulose** (*d*) **Lactose**

Ans. (*d*) Lactose

Questions 16 and 18

(A) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).

(C) Assertion (A) is correct, but Reason (R) is wrong statement.

(D) Assertion (A) is wrong, but Reason (R) is correct statement.

16. Assertion (A): An ideal solution obeys Henry's law.

Reason (R): In an ideal solution, solute-solute as well as solvent-solvent interactions are similar to solute-solvent interaction.

Ans. (D) 'A' is wrong statement 'R' is correct statement.

18. Assertion (A): Benzaldehyde is less reactive than ethanal towards nucleophilic addition reactions.

Reason (R): Ethanal is more sterically hindered.

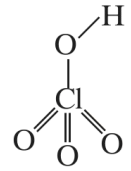
Ans. (C) 'A' is true statement 'R' is wrong statement.

SECTION – B

22. Draw the structures of the following:

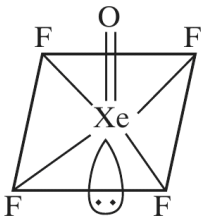
(*i*) **$HClO_4$** (*ii*) **$XeOF_4$** **1+1=2**

Ans. (*i*)



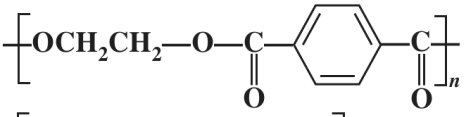
(Tetrahedral)

(*ii*)

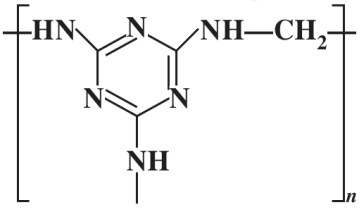


24. Identify the monomers in the following polymers:

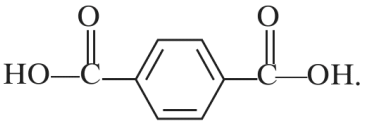
(*i*)



(*ii*)

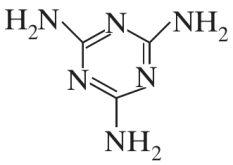
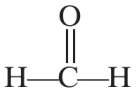


1+1=2

Ans. (*i*) $HOCH_2—CH_2OH$ and  .

Glycol

Terephthalic acid

(*ii*)  and 

Melamine

Methanal (Formaldehyde)

27. Define the following terms with a suitable example in each: **2**

(*i*) Bacteriocidal antibiotics

(*ii*) Food preservatives

Ans. (*i*) **Bactericidal antibiotics:** Those antibiotics which kill bacteria are called bacteriocidal antibiotics, e.g., Penicillin, Amino glycosides, Ofloxacin (*Any one*).

or

Those antibiotics which in low concentration inhibit the growth or destroy microorganism.

(*ii*) **Food preservatives:** Those chemicals which prevent undesirable changes in flavour, colour, texture and appetitic appeal during storage are called preservatives. They delay these changes and prevent spoilage of food due to microbial growth. The most common preservative is sodium benzoate, C_6H_5COONa. The salts of propanoic acid and sorbic acid are also used as preservatives.

SECTION – C

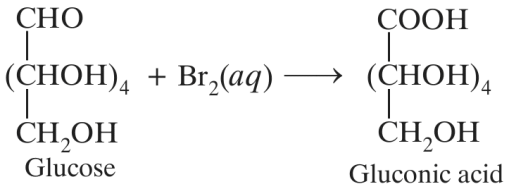
31. (*i*) What are the hydrolysis products of DNA?

(*ii*) What happens when D-glucose is treated with Bromine water?

(*iii*) What is the effect of denaturation on the structure of proteins? **1+1+1=3**

Ans. (*i*) Adenine, Guanine, Cytosine, Thymine, Deoxyribose and phosphoric acid are products of hydrolysis of DNA.

(*ii*) Gluconic acid is formed.



Glucose

Gluconic acid

(*iii*) **Denaturation of proteins:** On heating or change in pH, hydrogen bonds are disturbed, globules unfold and helix get uncoiled and leads to loss of biological activity, e.g. coagulation of egg white, curdling of milk.