Examination Papers, 2019

[Delhi Set-I, II, III]

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

Solution based on marking scheme by CBSE.

General Instructions:

(*i*) ***All** questions are compulsory.*

(*ii*) *Section A: Questions number **1** to **5** are very-short answer questions and carry **1** mark each.*

(*iii*) *Section B: Questions number **6** to **12** are short-answer questions and carry **2** marks each.*

(*iv*) *Section C: Questions number **13** to **24** are also short-answer questions and carry **3** marks each.*

(*v*) *Section D: Questions number **25** to **27** are long-answer questions and carry **5** marks each.*

(*vi*) *There is no overall choice. However, an internal choice has been provided in **two** questions of **one** mark, **two** questions of **two** marks, **four** questions of **three** marks and all the **three** questions of **five** marks weightage. You have to attempt only one of the choices in **such** questions.*

(*vii*) *Use log tables, if necessary. Use of calculators is **not** allowed.*

Set-I

SECTION — A

***1. Out of NaCl and AgCl, which one shows Frenkel defect and why?**

Ans. Out of syllabus.

2. Arrange the following in increasing order of boiling points:

$(CH_3)_3N$, C_2H_5OH, $C_2H_5NH_2$

Ans. $(CH_3)_3N < C_2H_5NH_2 < C_2H_5OH$ is increasing order of boiling point.

3. Why are medicines more effective in colloidal state?

OR

What is difference between an emulsion and a gel?

Ans. It is due to large surface area and medicines are easily assimilated in this form.

OR

Emulsion: When liquid is dispersed in another liquid, it is called emulsion, e.g. milk.

Gel: When liquid is dispersed in solid, it is called gel, e.g. cheese, butter, etc.

4. Define ambidient nucleophile with an example.

Ans. **Ambidient nucleophiles:** Those nucleophiles which can form bond through either of the two atoms are called ambident nucleophiles, *e.g.* CN^- can link through 'C' or 'N' to form cyanide or isocyanide as follows:

$$C_2H_5Cl + KCN \longrightarrow C_2H_5C{\equiv}N + KCl$$

$$C_2H_5Br + AgCN \longrightarrow C_2H_5N{=}C + AgBr$$

5. What is the basic structural difference between glucose and fructose?

OR

Write the products obtained after hydrolysis of lactose.

Ans. Glucose has aldehyde group whereas fructose has keto group.

OR

Lactose on hydrolysis give glucose and galactose.

SECTION — B

6. Write balanced chemical equations for the following processes:

(*i*) XeF_2 undergoes hydrolysis.

(*ii*) MnO_2 is heated with conc. HCl.

OR

Arrange the following in order of property indicated for each set:

(*i*) H_2O, H_2S, H_2Se, H_2Te — increasing acidic character.

(*ii*) HF, HCl, HBr, HI — decreasing bond enthalpy.

Ans. (*i*) $2XeF_2 + 2H_2O \longrightarrow 2Xe + 4HF + O_2$

(*ii*) $MnO_2 + 4HCl(conc.) \longrightarrow MnCl_2 + 2Cl_2 + 2H_2O$

OR

(*i*) $H_2O < H_2S < H_2Se < H_2Te$ is increasing order of acidic character.

(*ii*) HF > HCl > HBr > HI is decreasing order of bond enthalpy.

7. State Raoult's law for a solution containing volatile components. Write two characteristics of the solution which obeys Raoult's law at all concentrations.

Ans. (*i*) Raoult's law: It states that partial vapour pressure of each component is directly proportional to its mole fraction when both solute and solvent are volatile.

$$p_A \propto x_A \Rightarrow p_A = p_A^o x_A$$

and $$p_B \propto x_B \Rightarrow p_B = p_B^o x_B$$

(*ii*) 1. $\Delta H_{mix} = 0$

2. $\Delta V_{mix} = 0$

3. They follow Raoult's law.

4. They can be separated by fractional distillation. [*Any two*]

8. For a reaction

$$2H_2O_2 \xrightarrow[\text{alkaline medium}]{I^-} 2H_2O + O_2$$

the proposed mechanism is as given below:

1. $H_2O_2 + I^- \longrightarrow H_2O + IO^-$ (slow) 2. $H_2O_2 + IO^- \longrightarrow H_2O + I^- + O_2$ (fast)

(*i*) Write rate law for the reaction.

(*ii*) Write the overall order of reaction.

(*iii*) Out of steps (1) and (2), which one is rate determining step?

Ans. (*i*) $\frac{dx}{dt} = k\,[H_2O_2]\,[I^-]$

There action is first order with respect to $[H_2O_2]$ and first order w.r.t $[I^-]$ although I^- is catalyst.

(*ii*) Overall order is 2.

(*iii*) Step (I) is rate determining step because it is slow step.

9. When MnO_2 is fused with KOH in the presence of KNO_3 as an oxidizing agent, it gives a dark green compound (A). Compound (A) disproportionates in acidic solution to give purple compound (B). An alkaline solution of compound (B) oxidises KI to compound (C) whereas an acidified solution of compound (B) oxidises KI to (D). Identify (A), (B), (C) and (D).

Ans. 'A' is potassium manganate (K_2MnO_4), 'B' is potassium permanganate ($KMnO_4$), 'C' is potassium iodate (KIO_3) and 'D' is molecular iodine.

$$2MnO_2 + 4KOH + O_2 \longrightarrow \underset{\text{'A'}}{2K_2MnO_4} + 2H_2O$$

(Dark green solution)

K_2MnO_4 gives MnO_4^{2-} ions which undergoes oxidation as well as reduction (disproportionation) into MnO_4^- and MnO_2.

$$\underset{\text{'B'}}{3MnO_4^{2-}} + 4H^+ \longrightarrow \underset{\text{'B'}}{3MnO_4^-} + MnO_2 + 2H_2O$$

Purple

Purple coloured $KMnO_4$ 'C' gives MnO_4^- ions which convert KI to KIO_3 in basic medium and 'A' (MnO_2) is also formed.

$$\underset{\text{'B'}}{2MnO_4^-} + H_2O + KI \longrightarrow 2MnO_2 + 2OH^- + \underset{\substack{\text{'C'}\\ \text{Potassium}\\ \text{iodate}}}{KIO_3}$$

In acidic medium, the iodide ion will oxidise to molecular iodine.

$$2MnO_4^- + 10\,I^- + 16\,H^+ \longrightarrow 2Mn^{2+} + \underset{\text{'D'}}{5I_2} + 8H_2O$$

10. Write IUPAC name of the complex $[Pt(en)_2Cl_2]$. Draw structures of geometrical isomers for this complex.

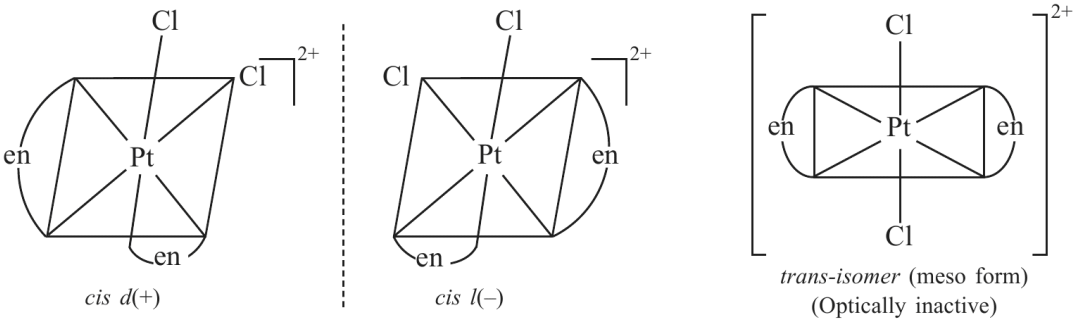
OR

Using IUPAC norms write the formulae for the following:

(*i*) Hexaamminecobalt(III) sulphate

(*ii*) Potassium trioxalatochromate(III).

Ans.



cis d(+) *cis l*(–) *trans-isomer* (meso form) (Optically inactive)

Dichlorido bis (ethane 1, 2-diamine) platinum II

OR

(*i*) $[Co(NH_3)_6]_2(SO_4)_3$

(*ii*) $K_3[Cr(C_2O_4)_3]$

11. Out of $[CoF_6]^{3-}$ and $[Co(en)_3]^{3+}$, which one complex is

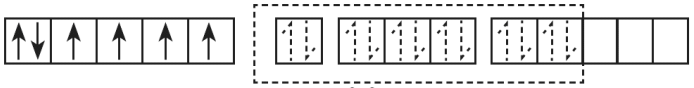
(*i*) paramagnetic **(*ii*) more stable**

(*iii*) inner orbital complex and **(*iv*) high spin complex**

(Atomic number of Co = 27)

Ans. (*i*) $[CoF_6]^{3-}$ is paramagnetic.

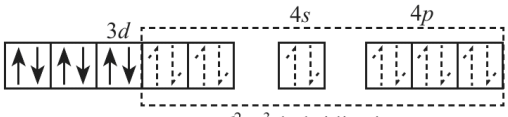
$[CoF_6]^{3-}$:



sp^3d^2 hybridisation

(*ii*) $[Co(en)_3]^{3+}$ is more stable.

(*iii*) $[Co(en)_3]^{3+}$ is inner orbital complex.

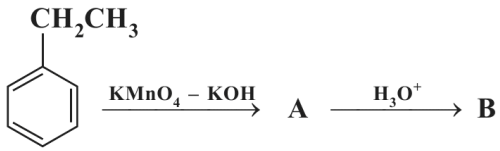


d^2sp^3 hybridisation

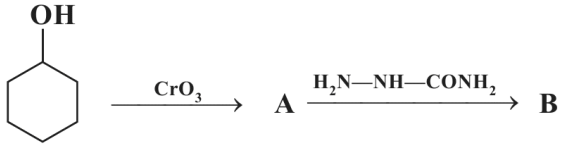
(*iv*) $[CoF_6]^{3-}$ is high spin complex.

12. Write structures of compounds A and B in each of the following reactions:

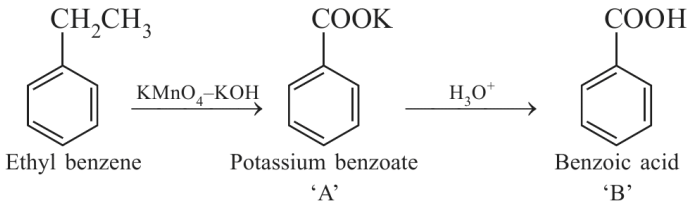
(*i*)



(*ii*)

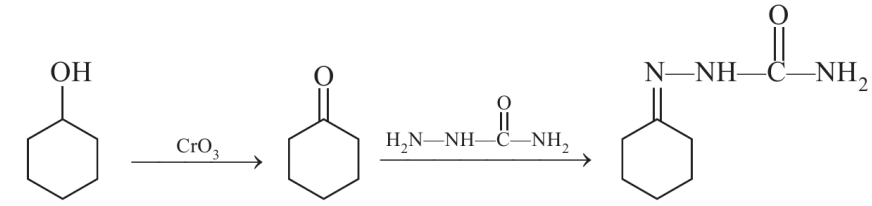


Ans. (*i*)



Ethyl benzene — Potassium benzoate 'A' — Benzoic acid 'B'

(*ii*)



Cyclohexanol — Cyclohexanone 'A' — Cyclohexanone semicarbazone 'B'

SECTION — C

13. The decomposition of NH_3 on platinum surface is zero order reaction. If rate constant (k) is 4×10^{-3} Ms^{-1}, how long will it take to reduce the initial concentration of NH_3 from 0.1 M to 0.064 M.

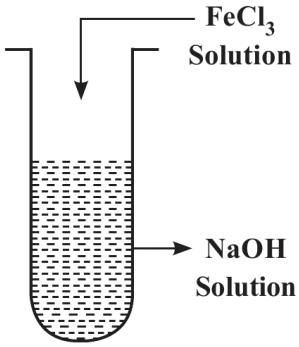
Ans. $k = 4 \times 10^{-3}$ Ms^{-1} $t = ?$ $[R]_0 = 0.1$ M $[R] = 0.064$ M

$$k = \frac{[R]_0 - [R]}{t}$$

$$\Rightarrow \quad 4 \times 10^{-3}\ Ms^{-1} = \frac{0.1 - 0.064}{t} \quad \Rightarrow \quad t = \frac{0.1 - 0.064}{4 \times 10^{-3}} = \frac{0.036}{0.004} = 9 \text{ seconds.}$$

14. (*i*) What is the role of activated charcoal in gas mask?

(*ii*) A colloidal sol is prepared by the given method in figure. What is the charge on hydrated ferric oxide colloidal particles formed in the test tube? How is the sol represented?



(*iii*) How does chemisorption vary with temperature?

Ans. (*i*) Activated charcoal adsorbs poisonous gases but not oxygen, therefore, it is used to save us from harmful gases.

(*ii*) Since NaOH is in excess, therefore, negatively charged colloid will be formed. $Fe(OH)_3/OH^-$ is representation of $Fe_2O_3.xH_2O/OH^-$.

(*iii*) Chemisorption first increases and then decreases with increase in temperature because some activation energy is needed for formation of covalent bonds but at high temperature, bonds will break.

***15. An element crystallizes in *fcc* lattice with a cell edge of 300 pm. The density of the element is 10.8 g cm^{-3}. Calculate the number of atoms in 108 g of the element.**

Ans. Out of syllabus.

16. A 4% solution (w/w) of sucrose (M = 342 g mol^{-1}) in water has a freezing point of 271.15 K. Calculate the freezing point of 5% glucose (M = 180 g mol^{-1}) in water. (Given: Freezing point of pure water = 273.15 K)

Ans. $W_B = 4$ g, $W_A = 100 - 4 = 96$ g, $M_B = 342$ g mol^{-1}, $\Delta T_f = 273.15\text{ K} - 271.15\text{ K} = 2.0$ K,

$$2.0\text{ K} = \Delta T_f = K_f \times \frac{W_B}{M_B} \times \frac{1000}{W_A} = K_f \times \frac{4}{342} \times \frac{1000}{96} \quad ...(i)$$

For Glucose:
$$\Delta T_f = K_f \times \frac{5}{180} \times \frac{1000}{95} \quad ...(ii)$$

Dividing (*i*) and (*ii*) we get

$$\frac{2.0}{\Delta T_f} = \frac{4}{342} \times \frac{180}{5} \times \frac{1000}{96} \times \frac{95}{1000}$$

$$= \frac{4 \times 36 \times 95}{342 \times 96} = \frac{36 \times 95}{342 \times 24} = \frac{3420}{8208}$$

$$\Delta T_f = \frac{2.0 \times 8208}{3420} = \frac{16416}{3420} = 4.8\text{ K}$$

Freezing point of Glucose solution = Freezing point of water $-\Delta T_f$

$= 273.15 - 480\text{ K} = 268.35$ K

17. (*a*) Name the method of refining which is

(*i*) used to obtain semicondutor of high purity,

(*ii*) used to obtain low boiling metal.

(*b*) Write chemical reactions taking place in the extraction of copper from Cu_2S.

Ans. (*a*) (*i*) Zone refining (*ii*) Distillation

(*b*) $2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2$

$Cu_2S + 2Cu_2O \longrightarrow 6Cu + SO_2$

18. Give reasons for the following:

(*i*) Transition elements and their compounds act as catalysts.

(*ii*) E° value for ($Mn^{2+}|Mn$) is negative whereas for ($Cu^{2+}|Cu$) is positive.

(*iii*) Actinoids show irregularities in their electronic configuration.

Ans. (*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 Mn^{2+} is stable due to exactly half filled $3d^5$ configuration. ECu_2^+/Cu is +ve due to high enthalpy of atomisation and low hydration enthalpy.

(*iii*) All actinoids are radioactive and some of them of very short half life. They have comparable energy of 7*s*, 6*d* and 5*f* orbitals, therefore, irregularity in their electronic configuration.

19. Write the structures of monomers used for getting the following polymers:

(*i*) Nylon-6, 6

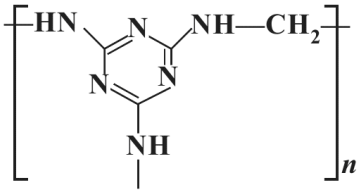
(*ii*) Glyptal

(*iii*) Buna-S

OR

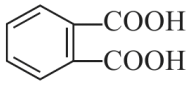
(*i*) Is $+CH_2—\underset{CH_3}{\underset{|}{C}}H+_n$ a homopolymer or copolymer? Give reason.

(*ii*) Write the monomers of the following polymer:



(*iii*) What is the role of Sulphur in vulcanization of rubber?

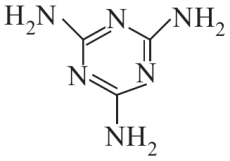
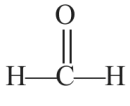
Ans. (*i*) Hexa methylene diamine (Hexane 1,6 diamine, $H_2N(CH_2)_6NH_2$) and $HO—\overset{O}{\overset{\|}{C}}—(CH_2)_4—\overset{O}{\overset{\|}{C}}—OH$ (Adipic acid, Hexane 1,6-dioic acid)

(*ii*) Glycol ($CH_2OH—CH_2OH$) and  (Phthalic acid)

(*iii*) Buta-1, 3-diene ($CH_2=CH—CH=CH_2$) and vinyl cyanide ($CH_2=CH—CN$)

OR

(*i*) It is homopolymer because it is polymer of only one type of monomer.

(*ii*)  and 

Melamine

Methanal (Formaldehyde)

(*iii*) Sulphur helps in formation of cross linkages between monomers which makes it hard, more elastic and more tensile strength.

20. (*i*) What type of drug is used in sleeping pills?

(*ii*) What type of detergents are used in toothpastes?

(*iii*) Why the use of alitame as artificial sweetener is not recommended?

OR

Define the following terms with a suitable example in each:

(*i*) Broad-spectrum antibiotics.

(*ii*) Disinfectants.

(*iii*) Cationic detergents.

Ans. (*i*) Hypnotics. e.g., chloretone.

(*ii*) Anionic detergents.

(*iii*) Its sweetness cannot be controlled.

OR

(*i*) **Broad spectrum antibiotics** are effective against large number of micro-organisms, *e*.g. Chloramphenicol is a broad spectrum antibiotic. It is readily absorbed in gastro-intestinal tract and hence can be given orally in case of typhoid, dysentery and acute fever, certain type of urinary infections, meningitis and pneumonia.

(*ii*) **Disinfectants:** They kill micro-organisms but are not safe for contact with living tissues. These are applied to inanimate objects such as floor, instruments, walls, etc. 2% solution of phenol acts as disinfectant, 0.2 to 0.4 parts per million is used for disinfecting drinking water and low concentration of SO_2 is used for sterilising squashes for preservation.

(*iii*) **Cationic detergents:** These are mostly acetates or chlorides or bromides of quarternary ammonium salts. They are more expensive, therefore used to limited extent. Such detergents possess germicidal properties and are used extensively as germicides, e.g. cetyl trimethyl ammonium chloride $[CH_3(CH_2)_{15}N(CH_3)_3]^+Cl^-$ is cationic detergent.

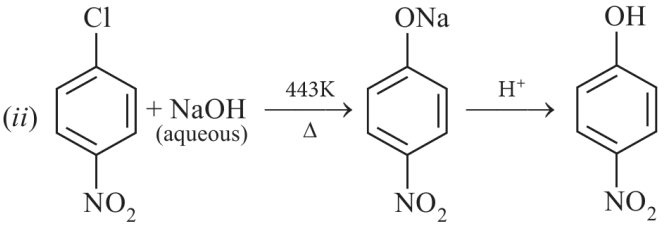
21. (*i*) Out of $(CH_3)_3C$—Br and $(CH_3)_3C$—I, which one is more reactive towards S_NI and why?

(*ii*) Write the product formed when *p*-nitrochlorobenzene is heated with aqueous NaOH at 443 K followed by acidification.

(*iii*) Why *dextro* and *laevo* – rotatory isomers of Butan-2-ol are difficult to separate by fractional distillation?

Ans. (*i*) (CH_3) C—I will be more reactive because C—I has lower bond dissociation enthalpy than C—Br bond, due to longer bond length.

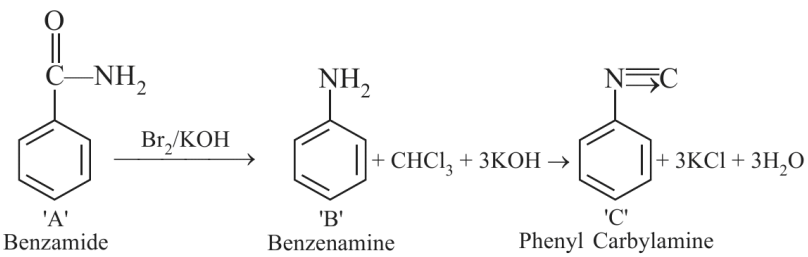
(*ii*)



(*iii*) It is because they do not differ appreciably in their boiling points (physical properties), differ in optical rotation and biological properties.

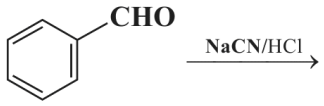
22. An aromatic compound 'A' on heating with Br_2 and KOH forms a compound 'B' of molecular formula C_6H_7N which on reacting with $CHCl_3$ and alcoholic KOH produces a foul smelling compound 'C'. Write the structures and IUPAC names of compounds A, B and C.

Ans.



'A' is Benzamide, 'B' is Benzenamine, 'C' is isocyanobenzene.

23. Complete the following reactions:

(*i*) 

(*ii*) $(C_6H_5CH_2)_2Cd + 2CH_3COCl \longrightarrow$

(*iii*) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-COOH \xrightarrow[(ii)\ H_2O]{(i)\ Br_2/Red\ P_4}$

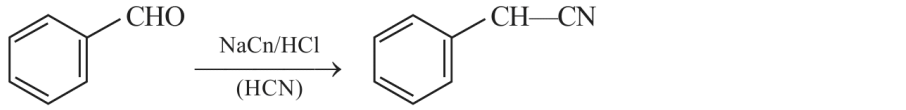
OR

Write chemical equations for the following reactions:

(*i*) Propanone is treated with dilute $Ba(OH)_2$.

(*ii*) Acetophenone is treated with Zn(Hg)/Conc. HCl

(*iii*) Benzoyl chloride is hydrogenated in presence of $Pd/BaSO_4$.

Ans. (*i*) 

Benzaldehyde — Benzaldehyde cyanohydrin (2-hydroxy-2-phenyl ethane)

(*ii*) $(C_6H_5-CH_2)_2Cd + 2CH_3COCl \longrightarrow 2C_6H_5-CH_2-\overset{\displaystyle O}{\overset{\|}{C}}-CH_3 + CdCl_2$

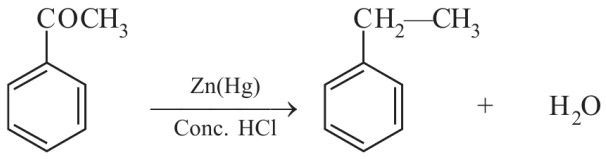
Dibenzyl Cadmium — Acetyl Chloride — 1-Phenyl propan-2-one

(*iii*) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-COOH \xrightarrow[(ii)\ H_2O]{(i)\ Br_2/RedP_4} CH_3-\underset{\displaystyle Br}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{C}}}}-COOH$

OR

(*i*) $2CH_3-\overset{\displaystyle O}{\overset{\|}{C}}-CH_3 \xrightarrow{dil.\ Ba(OH)_2} CH_3-\underset{\displaystyle CH_3}{\underset{|}{\overset{\displaystyle OH}{\overset{|}{C}}}}-CH_2-\overset{\displaystyle O}{\overset{\|}{C}}-CH_3$

Acetone (Propanone) — 4-hydroxy-4-methyl pentan-2-one

(*ii*) 

Acetophenone — Ethyl benzene

(*iii*) $C_6H_5-\overset{\displaystyle O}{\overset{\|}{C}}-Cl + H_2 \xrightarrow{Pd/BaSO_4} C_6H_5-\overset{\displaystyle O}{\overset{\|}{C}}-H + HCl$

24. Differentiate between the following:

(*i*) Amylose and Amylopectin

(*ii*) Peptide linkage and Glycosidic linkage

(*iii*) Fibrous proteins and Globular proteins

OR

Write chemical reactions to show that open structure of D-glucose contains the following:

(*i*) Straight chain

(*ii*) Five alcohol groups

(*iii*) Aldehyde as carbonyl group

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*) **Peptide bond or peptide linkage:** The bond $-\left(-\overset{\overset{O}{\|}}{C}-NH-\right)-$ between two or more amino acids in polypeptides and proteins.

Glycosidic linkage: It is oxide linkage between two or more monosaccharide units in Polysaccharides.

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

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

OR

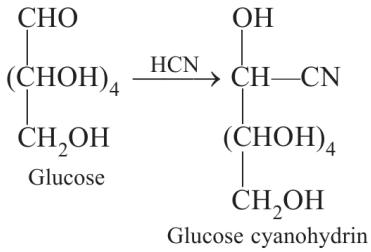
(*i*) *n*-hexane is formed, $CH_3—CH_2—CH_2—CH_2—CH_2—CH_3$

$$\begin{array}{l} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array} + HI \longrightarrow \underset{\text{n-hexane}}{CH_3—(CH_2)_4—CH_3}$$

(*ii*)
$$\underset{\text{Glucose}}{\begin{array}{l} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}} + 5(CH_3CO)_2O \longrightarrow 5CH_3COOH + \underset{\text{Glucose pentaacetate}}{\begin{array}{l} CHO \\ | \\ (CHOCOCH_3)_4 \\ | \\ CH_2OCOCH_3 \end{array}}$$

(*iii*)
$$\underset{\text{D-Glucose}}{\begin{array}{l} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}} + Br_2(aq) \longrightarrow \underset{\text{Gluconic acid}}{\begin{array}{l} COOH \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}}$$

or



Glucose

Glucose cyanohydrin

SECTION — D

25. **E°_{cell} for the given redox reaction is 2.71 V.**

$$Mg(s) + Cu^{2+}_{(0.01\ M)} \longrightarrow Mg^{2+}_{(0.001\ M)} + Cu(s)$$

Calculate E_{cell} for the reaction. Write the direction of flow of current when an external opposite potential applied is

(*i*) less than 2.71 V and

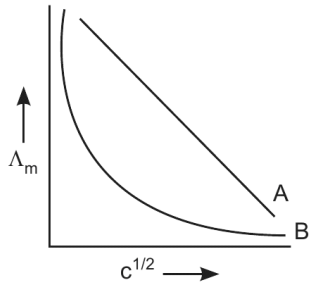
(*ii*) greater than 2.71 V

OR

(*a*) A steady current of 2 amperes was passed through two electrolytic cells X and Y connected in series containing electrolytes $FeSO_4$ and $ZnSO_4$ until 2.8 g of Fe deposited at the cathode of cell X. How long did the current flow? Calculate the mass of Zn deposited at the cathode of cell Y.

(Molar Mass: Fe = 56 g mol^{-1}, Zn = 65.3 g mol^{-1}, 1F = 96500 C mol^{-1})

(*b*) In the plot of molar conductivity (Λ_m) vs square root of concentration ($c^{1/2}$), following curves are obtained for two electrolytes A and B:



Answer the following:

(*i*) Predict the nature of electrolytes A and B.

(*ii*) What happens on extrapolation of Λ_m to concentration approaching zero for electrolytes A and B?

Ans. (*i*) If external opposite potential is less than 2.71 V, the flow of current will be from (copper) cathode to anode (Mg).

(*ii*) If external opposite potential is greater than 2.71 V, current will flow from cathode (Mg) to anode (copper) cathode will become anode and anode will become cathode. Mg (cathode), Cu (anode).

$$Mg(s) \longrightarrow Mg^{2+} + 2e^-$$

$$Cu^{2+} + 2e^- \longrightarrow Cu(s)$$

$$E_{cell} = E^\circ_{cell} - \frac{2.303\,RT}{nF} \log \frac{[Mg^{2+}]}{[Cu^{2+}]}$$

$$= 2.71\ V - \frac{0.0591}{2} \log \frac{10^{-3}}{10^{-2}}$$

$$= 2.71\ V - 0.0295 \log 10^{-1}$$

$$= 2.71\ V + 0.0295 \qquad [\because \log 10^{-1} = -1]$$

$$E_{cell} = 2.7395\ V = 2.74\ V$$

OR

(*a*) I = 2 A, t = ?,

Atomic weight of Fe = 56 g mol^{-1}, Z = 65.3 g mol^{-1}, m = 2.8 g

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

$$2.8 = \frac{56}{2 \times 96500} \times 2 \times t$$

$$Z = \frac{\text{Eq. wt}}{96500} = \frac{\text{Atomic mass}}{\text{valency} \times 96500} = \frac{56}{2 \times 96500} \text{ for Iron}$$

$$t = \frac{2.8 \times 2 \times 96500}{56 \times 2} = 4825\ s$$

$$t = \frac{4825}{60 \times 60} = 1.34 \text{ hours}$$

$$\frac{m_{Zn}}{E_{Zn}} = \frac{m_{Fe}}{E_{Fe}}$$

$$\Rightarrow \quad \frac{m_{Zn}}{\frac{65.3}{2}} = \frac{2.8}{\frac{56}{2}}$$

$$\Rightarrow \quad m_{Zn} = \frac{2.8}{28} \times \frac{65.3}{2} = 3.265\ g$$

(*b*) (*i*) 'A' is strong electrolyte, 'B' is weak electrolyte.

(*ii*) Λ°_m (limiting molar conductivity) of 'A' can be obtained by extrapolation but Λ°_m of 'B' cannot be obtained because a curve cannot be extrapolated.

26. **(*a*) How do you convert the following:**

(*i*) Phenol to Anisole

(*ii*) Ethanol to Propan-2-ol

(*b*) Write the mechanism of the following reaction:

$$C_2H_5CH_2OH \xrightarrow[443\ K]{H_2SO_4} CH_2{=}CH_2 + H_2O$$

(*c*) Why phenol undergoes electrophilic substitution more easily than benzene?

OR

(*a*) Account for the following:

(*i*) *o*-nitrophenol is more steam volatile than *p*-nitrophenol.

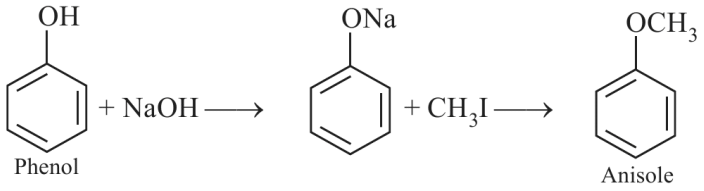
(*ii*) *t*-butyl chloride on heating with sodium methoxide gives 2-methylpropene instead of *t*-butylmethylether.

(*b*) Write the reaction involved in the following:

(*i*) Reimer-Tiemann reaction

(*ii*) Friedal-Crafts Alkylation of Phenol.

(*c*) Give simple chemical test to distinguish between Ethanol and Phenol.

Ans. (*a*) (*i*) 

(*ii*) $CH_3CH_2OH \xrightarrow[573K]{Cu} CH_3-\overset{O}{\overset{\|}{C}}-H \xrightarrow[(ii)\ H_2O/H^+]{(i)\ CH_3MgBr} CH_3-\overset{OH}{\overset{|}{CH}}-CH_3$

Ethanol — Ethanal — 2-Propanol

(*b*) When ethanol is heated with concentrated sulphuric acid at 443 K, ethene is formed.

$$CH_3CH_2OH \xrightarrow[443\ K]{Conc.\ H_2SO_4} CH_2{=}CH_2 + H_2O$$

$$H_2O + H^+ \longrightarrow H_3O^+$$

Mechanism:

(*i*) $CH_3CH_2\ddot{\underset{\cdot\cdot}{O}}H + H_3O^+ \longrightarrow CH_3-CH_2-\overset{\oplus}{\underset{\cdot\cdot}{O}}(H)-H + H_2O$

(*ii*) $CH_3CH_2-\overset{\oplus}{\underset{\cdot\cdot}{O}}(H)-H \longrightarrow CH_3\overset{\oplus}{C}H_2 + H_2O$

(*iii*) $H-\underset{H}{\overset{H}{C}}-\overset{H}{\underset{H}{\overset{\oplus}{C}}} + H_2O \longrightarrow H-C{=}C-H + H_3O^+$

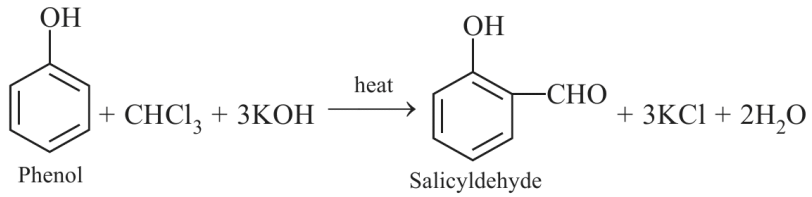
(*c*) It is because –OH group is electron releasing, activating, therefore, it undergoes electrophilic substitution more readily than benzene.

OR

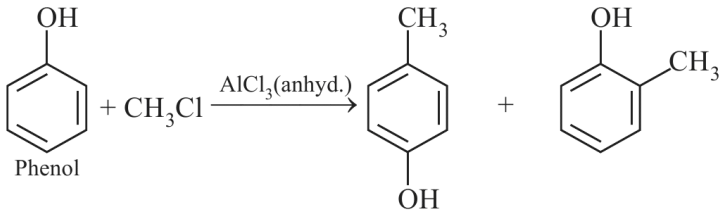
(*a*) (*i*) Ortho nitrophenol is steam volatile because of weak intra-molecular H-bonding, whereas *p*-nitrophenol is associated with inter-molecular H-bonding. Therefore, it is not steam volatile.

(*ii*) It is due to –I and –R effect of —NO_2 group and +I and +R effect of CH_3 group, *p*-nitrophenoxide ion is more stable than *p*-methyl phenoxide ion.

(*b*) (*i*) **Reimer–Tiemann reaction:** When phenol is heated with $CHCl_3$ and KOH, salicylaldehyde is formed.



(*ii*)



(*c*) Add neutral $FeCl_3$. Ethanol does not react. Phenol gives violet colour.

27. (*a*) Give reasons for the following:

(*i*) Sulphur in vapour state shows paramagnetic behaviour.

***(*ii*) N—N bond is weaker then P—P bond.**

(*iii*) Ozone is thermodynamically less stable than oxygen.

***(*b*) Write the name of gas released when Cu is added to**

(*i*) dilute HNO_3 and

(*ii*) conc. HNO_3

OR

(*a*) *(*i*) Write the disproportionation reaction of H_3PO_3.

(*ii*) Draw the structure of XeF_4.

(*b*) Account for the following:

(*i*) Although Fluorine has less negative electron gain enthalpy yet F_2 is strong oxidizing agent.

***(*ii*) Acidic character decreases from N_2O_3 to Bi_2O_3 in group 15.**

(*c*) Write a chemical reaction to test sulphur dioxide gas. Write chemical equation involved.

Ans. (*a*) (*i*) It is due to presence of unpaired electron in sulphur like O_2.

(*ii*) Out of syllabus.

(*iii*) It is because O_3 has low bond dissociation energy due to which it is more reactive, therefore, it liberates nascent oxygen easily.

$$O_3 \longrightarrow O_2 + [O]$$

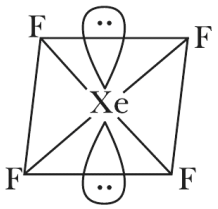
(*b*) (*i*) Out of syllabus.

(*ii*) Out of syllabus.

OR

(*a*) (*i*) Out of syllabus.

(*ii*)



(*b*) (*i*) It is because F_2 has higher standard reduction potential.

(*ii*) Out of syllabus.

(*c*) Pass SO_2 gas through acidified potassium dichromate.

It will become green.

$$Cr_2O_7^{2-} + 3SO_2 + 2H^+ \longrightarrow \underset{\text{(Green)}}{2Cr^{3+}} + 3SO_4^{2-} + H_2O$$

Set-II (Uncommon Questions to Set-I)

SECTION — A

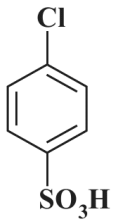
2. Arrange the following in increasing order of base strength in gas phase:
$(C_2H_5)_3N$, $C_2H_5NH_2$, $(C_2H_5)_2NH$

Ans. $C_2H_5NH_2 < (C_2H_5)_2NH < (C_2H_5)_3N$ is increasing order of base strength in gas phase.

***3. Why conductivity of silicon increases on doping with phosphorus?**

Ans. Out of syllabus.

5. Write IUPAC name of the given compound:



Ans. 4-Chlorobenzene sulphonic acid.

SECTION — B

8. Write two difference between ideal solutions and non-ideal solution.

Ans.

Ideal solution	Non-ideal solution
(*i*) It obey Raoult's law at every range of concentration (at all values of concentration)	(*i*) It does not obey Raoult's law.
(*ii*) $\Delta H_{mix} = 0$, $\Delta V_{mix} = 0$	(*ii*) $\Delta H_{mix} \neq 0$, $\Delta V_{mix} \neq 0$

10. Write IUPAC name of the complex $[Cr(NH_3)_4Cl_2]^+$. Draw structures of geometrical isomers for this complex.

OR

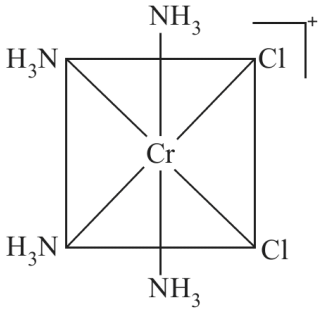
Using IUPAC norms write the formulae for the following:

(*i*) Pentaamminenitrito-O-cobalt(III) chloride

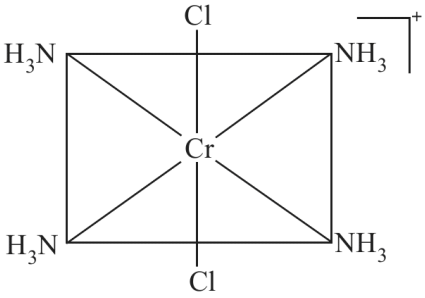
(*ii*) Potassium tetracyanidonickelate(II)

Ans. Tetraamminedichloridochromium(III).

It exhibits geometrical isomerism.



cis-isomer



trans-isomer

OR

(*i*) $[Co(NH_3)_5ONO]Cl_2$

(*ii*) $K_2[Ni(CN)_4]$

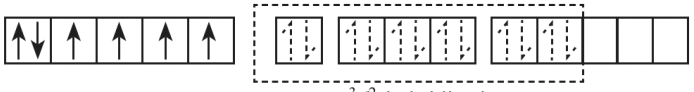
11. Out of $[CoF_6]^{3-}$ and $[Co(C_2O_4)_3]^{3-}$, which one complex is

(*i*) diamagnetic **(*ii*) more stable**

(*iii*) outer orbital complex **(*iv*) low spin complex?**

Ans. (*i*) $[CoF_6]^{3-}$ is paramagnetic and $[Co(C_2O_4)_3]^{3-}$ is diamagnetic.

$[CoF_6]^{3-}$:



sp^3d^2 hybridisation

(*ii*) $[Co(C_2O_4)_3]^{3-}$ is more stable.

(*iii*) $[CoF_6]^{3-}$ is outer orbital complex.

(*iv*) $[Co(C_2O_4)_3]^{3-}$ is low spin complex.

SECTION — C

***13. An element crystallizes in fcc lattice with a cell edge of 300 pm. The density of the element is 10.8 g cm^{-3}. Calculate the number of atoms in 108 g of the element.**

Ans. Out of syllabus.

17. (*i*) Write the role 'CO' in the purification of nickel

(*ii*) State the role of silica in the metallurgy of copper.

(*iii*) What type of metals are generally extracted by electrolytic method?

Ans. (*i*) CO reacts with impure Ni to form $Ni(CO)_4$ which decomposes to form pure Ni on heating.

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

(*ii*) It acts as flux. It reacts with FeO to form $FeSiO_3$ (slag) which can be easily removed.

$FeO + SiO_2 \longrightarrow FeSiO_3$

(*iii*) Highly reactive metals are generally extracted by electrolytic method.

18. Give reasons for the following:

(*i*) Transition metals form alloys.

(*ii*) Mn_2O_3 is basic whereas Mn_2O_7 is acidic.

(*iii*) Eu^{2+} is a strong reducing agent.

Ans. (*i*) Transition metal do not differ appreciably in their size, therefore, can replace each other in metallic bond and form alloys.

(*ii*) In Mn_2O_3, Mn is in +3 oxidation state, it forms $Mn(OH)_3$ on heating with water, therefore, it is basic.

Mn_2O_7 is acidic because Mn^{7+} (highest oxidation state), dissolves in water forming $HMnO_4$ (Permanganic acid), therefore, acidic in nature.

(*iii*) Eu^{2+} can lose on electron to form Eu^{3+} which has higher hydration energy, therefore, easily formed.

20. (*i*) Why bithional is added in soap?

(*ii*) Why soaps are biodegradable whereas detergents are non-biodegradable?

OR

Define the following terms with a suitable example in each:

(*i*) Antibiotics

(*ii*) Artificial sweeteners

(*iii*) Analgesics.

Ans. (*i*) It is added to soaps to impart antiseptic properties.

(*ii*) Soaps are 100% biodegradable because it is decomposed by micro-organisms and does not create water pollution.

OR

(*i*) **Antibiotics:** Those drugs which kill or prevent the growth of bacteria and other micro-organisms are called antibiotics, *e.g.* Streptomycin.

(*ii*) **Artificial sweetener:** Sweetening agents which do not add calories for diabetic and over weight (obese) people, e.g. saccharine, alitame, aspartame, sucralose.

(*iii*) **Analgesics:** Those drugs, which relieve or decrease pain without causing unconsciousness, paralysis or incoordination, mental confusion are termed as analgesics. Aspirin, analgin, seridon, anacine, aspro, morphine, codeine. (*any one example*)

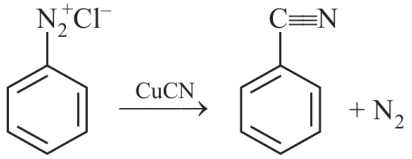
21. Write the structures of main products when benzene diazonium chloride reacts with the following reagents:

(*i*) CuCN

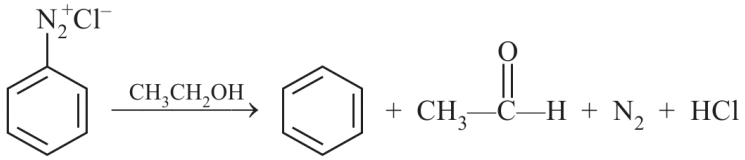
(*ii*) CH_3CH_2OH

(*iii*) KI

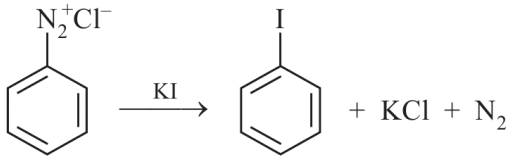
Ans. (*i*)



(*ii*)



(*iii*)



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

SECTION — A

1. Arrange the following in decreasing order of solubility in water:

$(CH_3)_3N$, $(CH_3)_2NH$, CH_3NH_2

Ans. $CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N$ is decreasing order of solubility in water.

***2. What type of stoichiometric defect is shown by ZnS and why?**

Ans. Out of syllabus.

3. Write one stereochemical difference between S_N1 and S_N2 reactions.

Ans. In S_N1, racemisation takes place, whereas in S_N2 mechanism stereochemical inversion (optical inversion) takes place.

SECTION — B

7. State Henry's law and write its two applications.

Ans. **Henry's Law:** It states that the partial vapour pressure of a gas in vapour phase (p) is directly proportional to the mole fraction of the gas (x) in the solution.

Mathematically, $p = K_H \times x$

where K_H is Henry's law contant.

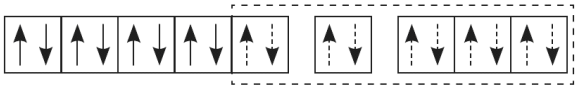
Applications of Henry's Law:

(i) To minimise the painful effects accompanying the decompression of deep sea divers (bends), oxygen diluted with less soluble helium gas is used as breathing gas.

(ii) To increase the solubility of CO_2 in soft drinks and soda water, the bottle is sealed under high pressure.

11. Write the hybridisation, and magnetic character of $[Fe(CO)_5]$.

Ans. $[Fe(CO)_5]$

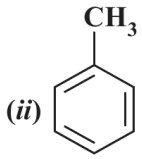


dsp^3

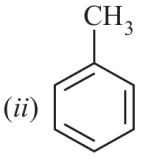
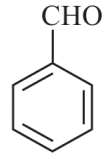
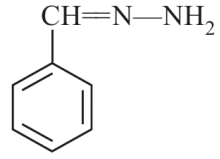
It has dsp^3 hybridisation, trigonal bipyramidal shape, diamagnetic.

12. Write structures of main compounds A and B in each of the following reactions:

(i) $\mathbf{CH_3CH_2CN \xrightarrow{CH_3MgBr/H_3O^+} A \xrightarrow{LiAlH_4} B}$

(ii)  $\xrightarrow[(ii)\ H_3O^+/\Delta]{(i)\ CrO_3/(CH_3CO)_2O}$ **A** $\xrightarrow{H_2N—NH_2}$ **B**

Ans. (i) $CH_3CH_2CN \xrightarrow{CH_3MgBr/H_3O^+} CH_3CH_2\overset{\overset{O}{\|}}{C}—CH_3$ ('A') $\xrightarrow{LiAlH_4} CH_3CH_2\overset{\overset{OH}{|}}{C}H—CH_3$ ('B')

(ii)  $\xrightarrow[(ii)\ H_3O^+/\Delta]{(i)\ CrO_3/(CH_3CO)_2O}$  ('A') $\xrightarrow{H_2N—NH_2}$  ('B')

SECTION — C

17. How will you convert the following:

(i) Impure Nickel to pure Nickel

(ii) Zinc blende to Zinc metal

(iii) $[Ag(CN)_2]^-$ to Ag

Ans. (*i*) $Ni + 4CO \longrightarrow \underset{\text{(Impure)}}{Ni(CO)_4}$

$$Ni(CO)_4 \xrightarrow{\text{Heat}} \underset{\text{(Pure)}}{Ni} + 4CO$$

(*ii*) $2ZnS + 3O_2 \longrightarrow 2ZnO + 2SO_2$

$ZnS + 2ZnO \longrightarrow 3Zn + SO_2$

OR

$ZnO + C \longrightarrow Zn + CO$

(*iii*) $2[Ag(CN)_2]^- + Zn \longrightarrow [Zn(CN)_4]^{2-} + 2Ag$

18. Give reasons for the following:

(*i*) The transition metals generally form coloured compounds.

(*ii*) The E° value for the Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+} couple or Fe^{3+}/Fe^{2+} couple.

(*iii*) The Chemistry of actinoids elements is not so smooth as that of the lanthanoids.

Ans. (*i*) It is because their high ionic charges, comparatively smaller sizes of the metal ions and the availability of *d*-orbitals for bond formation.

(*ii*) It is because Mn^{2+} is more stable than Mn^{3+} due to stable half filled $3d^5$ configuration, whereas $Cr^{3+}(t_{2g}^3)$ and $Fe^{3+}(3d^5)$ are more stable than Cr^{2+} and Fe^{2+} respectively.

(*iii*) It is because all actinoids are radioactive and some of them very short half life.

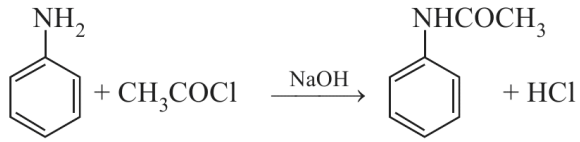
22. Write equations of the following reactions:

(*i*) Acetylation of aniline

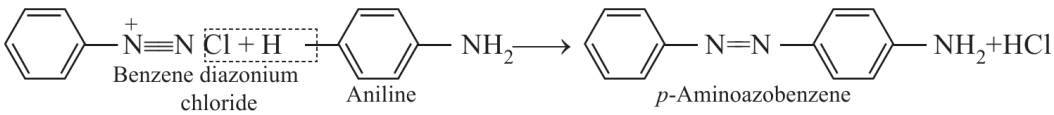
(*ii*) Coupling reaction

(*iii*) Carbyl amine reaction

Ans. (*i*) **Acetylation or acylation:** The process, in which acetyl group ($CH_3—\overset{\overset{O}{\|}}{C}—$) is introduced, is called acetylation. It is done by reaction with acetyl chloride or acetic anhydride. It reduces its activation effect because $CH_3—\overset{\overset{O}{\|}}{C}—$ is electron withdrawing.



(*ii*) **Coupling reaction:** When benzene diazonium chloride reacts with aniline or phenol, orange azo dye is formed.



(*iii*) **Carbyl amine reaction:** When primary amine reacts with $CHCl_3$ and KOH, it forms isocyanide which is an offensive smelling compound.

$$RNH_2 + CHCl_3 + 3KOH \longrightarrow RN{\equiv}C + 3KCl + 3H_2O$$

24. Define the following with a suitable example in each:

(*i*) Oligosaccharides (*ii*) Denaturation of protein (*iii*) Vitamins

OR

Write the reactions involved when D-glucose is treated with the following reagents:

(*i*) Br_2 water (*ii*) H_2N—OH (*iii*) $(CH_3CO)_2O$

Ans. (*i*) **Oligosaccharide:** They give 2 to 10 units of monosaccharide on hydrolysis, e.g. raffinose is trisaccharide of glucose, fructose and galactose.

(*ii*) **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.

(*iii*) **Vitamins:** Vitamins are the group of organic compounds which are required in very small amounts for the healthy growth and functioning of animal organism. They cannot be made by organism and so have to be part of our diet. The deficiency of a vitamin can cause a specific disease. Vitamins A, D, E and K are fat-soluble substances, whereas vitamin B complex and vitamin C are water-soluble.

OR

(*i*) $(CHOH)_4(CHO)(CH_2OH) + Br_2(aq) \longrightarrow (CHOH)_4(COOH)(CH_2OH)$

Glucose → Gluconic acid

(*ii*) $(CHOH)_4(CHO)(CH_2OH) + NH_2OH \longrightarrow (CHOH)_4(CH{=}NOH)(CH_2OH)$

Glucose + Hydroxyl amine → Glucose monoxime

(*iii*) $(CHOH)_4(CHO)(CH_2OH) + 5(CH_3CO)_2O \longrightarrow 5CH_3COOH + (CHOCOCH_3)_4(CHO)(CH_2OCOCH_3)$

Glucose + Acetic anhydride → Glucose pentaacetate