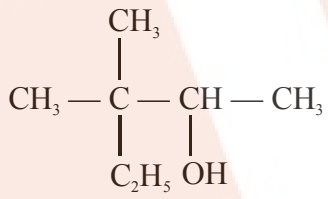
XII CBSE - BOARD - MARCH - 2018

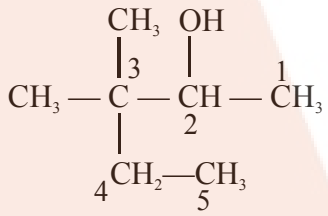
CODE (56/2) SET - 2

Date: 13.03.2018 **Chemistry - Solutions**

1. Write the IUPAC name of the following :



Ans.



3,3-dimethylpentan-2-ol

2. Out of chlorobenzene and benzyl chloride, which one gets easily hydrolysed by aqueous *NaOH* and why ?

Ans. Benzyl chloride will get easily hydrolysed as the halogen is attached to 1° carbon atom.

3. *CO*(*g*) and $H_2(g)$ react to give different products in the presence of different catalysts. Which ability of the catalyst is shown by these reactions ?

Ans. This ability is known as catalytic selectivity which implies that catalyst also can take part in the reaction.

4. Write the coordination number and oxidation state of Platinum in the complex $\left[Pt\left(en\right)_2 Cl_2 \right]$.

Ans. Coordination number = 6

Oxidation number = +2

5. Analysis shows that FeO has a non-stoichiometric composition with formula $Fe_{0.95}O$. Give reason.

Ans. As it is an interstitial compound they dont follow any particular stoichiometric composition.

6. Complete and balance the following chemical equations :

(a) $Fe^{2+} + MnO_4^- + H^+ \longrightarrow$

(b) $MnO_4^- + H_2O + I^- \longrightarrow$

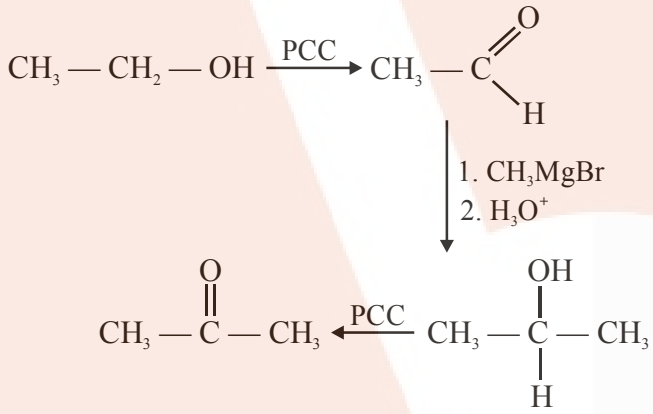
Ans. (a) $5Fe^{+2} + 2MnO_4^- + 8H^+ \longrightarrow 5Fe^{+3} + 2Mn^{+2} + 4H_2O$

(b) $2MnO_4^- + H_2O + I^- \longrightarrow 2MnO_2 + 2OH^- + IO_3^-$

7. How do you convert the following ?

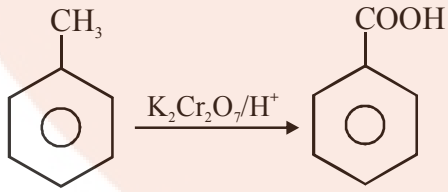
(a) Ethanal to Propanone

Ans.



(b) Toluene to Benzoic acid

Ans.



(OR)

Account for the following :

(a) Aromatic carboxylic acids do not undergo Friedel-Crafts reaction.

Ans. As *–COOH* group shows *–m* effect thus electron withdrawing in nature and makes the aromatic ring deactivated towards electrophilic substitution reaction.

(b) pK_a value of 4-nitrobenzoic acid is lower than that of benzoic acid.

Ans. Because of the presence of $–NO_2$ group which is highly electron withdrawing in nature. The polarity of *–OH* bond in *–COOH* increases thus acidity increases and pK_a decreases.

8. For the reaction

$$2N_2O_5(g) \longrightarrow 4NO_2(g) + O_2(g),$$

the rate of formation of $NO_2(g)$ is $2.8\times10^{-3} Ms^{-1}$. Calculate the rate of disappearance of $N_2O_5(g)$.

Ans. $2N_2O_5(g) \longrightarrow 4NO_2(g) + O_2(g)$

$$\text{Rate of reaction} = -\frac{1}{2}\frac{d[N_2O_5]}{dt} = \frac{1}{4}\frac{d[NO_2]}{dt} = \frac{d[O_2]}{dt}$$

According to question

$$\frac{d[NO_2]}{dt} = 2.8\times10^{-3} Ms^{-1}$$

$$-\frac{d[N_2O_5]}{dt} = \frac{2}{4}\frac{d[NO_2]}{dt} = \frac{1}{2}\times 2.8\times10^{-3} Ms^{-1} = 1.4\times10^{-3} Ms^{-1}$$

9. Among the hydrides of Group-15 elements, which have the

(a) Lowest boiling point ?

(b) Maximum basic character ?

(c) Highest bond angle ?

(d) Maximum reducing character ?

Ans. (a) Lowest boiling point = PH_3

(b) Maximum basic character = NH_3

(c) Highest bond angle = $\ddot{N}H_3$

(d) Maximum reducing character = BiH_3

10. Calculate the freezing point of a solution containing 60 g of glycose (Molar mass = 180 g mol^{-1}) in 250 g of water.

(K_f of water = 1.86 K kg mol^{-1})

Ans. We know

$$\Delta T_f = k_f \times m$$

$$m = \frac{60/180\, mol}{0.25\, kg} = 1.33 mol\, kg^{-1}$$

$$\Delta T_f = 1.86 \times 1.33 K$$

$$\Rightarrow \Delta T_f = 2.4738 K$$

$$\Rightarrow T_f^{\circ} - T_f = 2.4738 K$$

$$\Rightarrow T_f = T_f^{\circ} - 2.4738 K$$

$$= 273 - 2.4738 K$$

$$= 270.5262 K$$

11. An element '*X*' (At. mass = 40 g mol^{-1}) having f.c.c. structure, has unit cell edge length of 400 pm. Calculate the density of '*X*' and the number of unit cells in 4 g of '*X*'. ($N_A = 6.022 \times 10^{23} mol^{-1}$)

Ans. We know

$$d = \frac{Z \times M}{N_A \times a^3}$$

For *FCC Z* is 4

$$d = \frac{4 \times 40}{6.022 \times 10^{23} \times \left(400 \times 10^{-10}\right)^3} = 4.1514\, gm\, cm^{-3}$$

Volume of $4gm\ X$ is $\frac{4}{4.1514} cm^3 = 0.96\, cm^3$

Volume of 1unit cell is $= \left(400 \times 10^{-10}\right)^3 cm^3 = 64 \times 10^{-24} cm^3$

Number of unit cell $= \frac{0.96}{64 \times 10^{-24}} = 1.5 \times 10^{22}$

12 Give reasons for the following :

(a) Measurement of osmotic pressure method is preferred for the determination of molar masses of macromolecules such as proteins and polymers.

Ans. The osmotic pressure method has the advantage over other method as pressure measurement is around the room temperature and the molarity of the solution is used instead of molality. Also as compared to other colligative property its magnitude is large even for dilute solution.

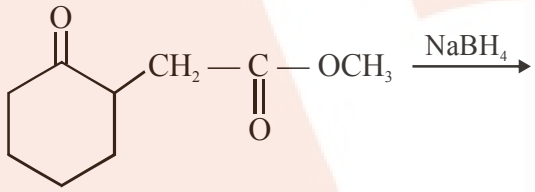
(b) Aquatic animals are more comfortable in cold water than in warm water.

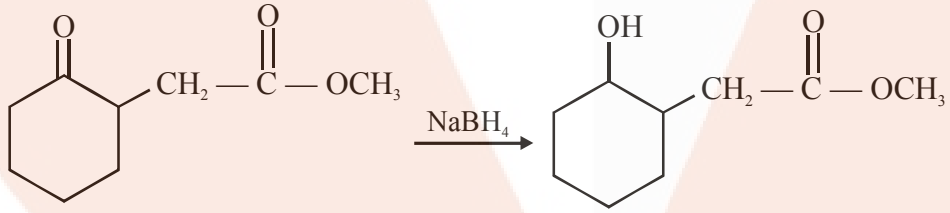
Ans. Because in cold water more oxygen is dissolved.

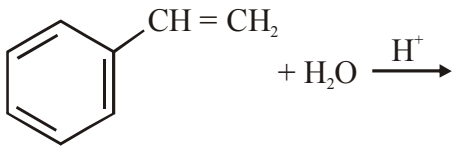
(c) Elevation of boiling point of 1 M KCl solution is nearly double than that of 1 M sugar solution.

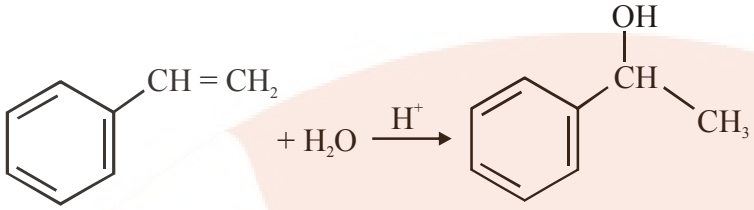
Ans. As colligative property depends only on number of particle and KCl as electrolyte will produce double number of particle of sugar.

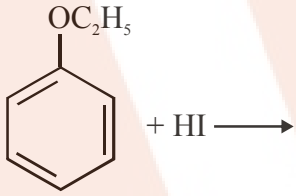
13. Write the structures of the main products in the following reactions :

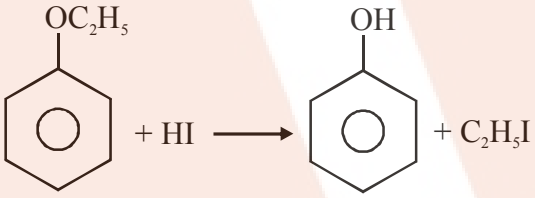
(i) 

Ans. 

(ii) 

Ans. 

(iii) 

Ans. 

14. (a) Write the formula of the following coordination compound :
Iron(III) hexacyanoferrate (II)

Ans. $Fe_4\left[Fe(CN)_6\right]_3$

(b) What type of isomerism is exhibited by the complex $\left[Co(NH_3)_5Cl\right]SO_4$?

Ans. Ionisation isomerism

(c) Write the hybridisation and number of unpaired electrons in the complex $\left[CoF_6\right]^{3-}$.
(Atomic No. of Co = 27)

Ans. Hybridisation $\rightarrow sp^3d^3$

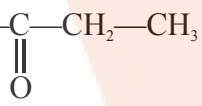
Number of unpaired electron $\rightarrow 4$

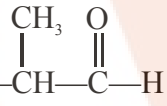
15. (A), (B) and (C) are three non-cyclic functional isomers of a carbonyl compound with molecular formula C_4H_8O. Isomers (A) and (C) give positive Tollen's test whereas isomer (B) does not give Tollen's test but gives positive Iodoform test. Isomers (A) and (B) on reduction with Zn(Hg)/conc. HCl give the same product (D).

(a) Write the structures of (A), (B), (C) and (D).

Ans. Structure of

(A) is $CH_3CH_2CH_2CHO$

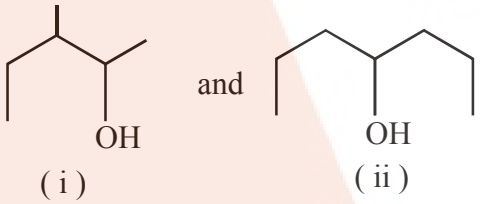
(B) is 

(C) is 

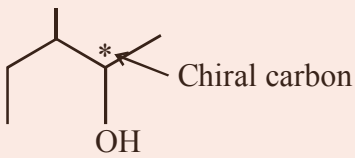
(b) Out of (A), (B) and (C) isomers, which one is least reactive towards addition of HCN ?

Ans. (B) will be least reactive as it contain ketone as functional group and ketones are less reactive than aldehyde towards nucleophilic addition reaction.

16. (a) Identify the chiral molecule in the following pair ?

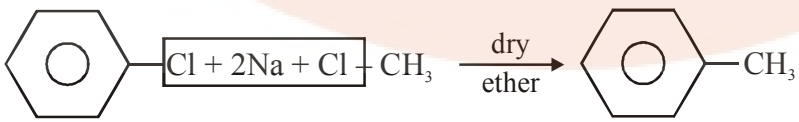


(i) (ii)

Ans. (i) 

(b) Write the structure of the product when chlorobenzene is treated with methyl chloride in the presence of sodium metal and dry ether.

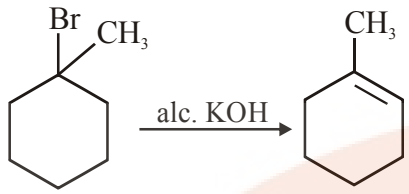
Ans.



Chlorobenzene Methylchloride Toluene

(c) Write the structure of the alkene formed by dehydrohalogenation of 1-bromo-1-methylcyclohexane with alcoholic KOH.

Ans.



17. Give reasons:

(a) E° value for Mn^{3+}/Mn^{2+} couple is much more positive than that for Fe^{3+}/Fe^{2+}.

Ans. Mn^{+3} / Mn^{+2} has large + ve value because Mn^{+3} can be easily reduced to Mn^{+2}. Mn^{+2} has a half filled d-orbital.

Fe^{+3} / Fe^{+2} has small + ve value because Fe^{+3} is more stable than Fe^{+2}. Fe^{+3} has a half filled d-orbitals.

$\therefore$ Mn^{+3} / Mn^{+2} couple is much more positive than that for Fe^{+3} / Fe^{+2}, Fe^{+3} more stable than Mn^{+3}

(b) Iron has higher enthalpy of atomization than that of copper.

Ans. Metallic bond in iron is stronger than that of copper. This is due to presence of higher number of unpaired electrons in iron.

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

Ans. Compounds of transition elements are coloured due to presence of unpaired electrons in d-orbitals as they show d-d-transition. In Sc^{+3} there are no d-electrons in Ti^{+3} there is one d-electrons.

18. Write the chemical reactions involved in the process of extraction of Gold. Explain the role of dilute NaCN and Zn in this process.

Ans. $4Au(s) + 8CN^-_{(aq)} + 2H_2O_{(aq)} + O_{2(g)} \longrightarrow 4[Au(CN)_2]^-_{(aq)} + 4OH^-_{(aq.)}$

$2[Au(CN)_2]^-_{(aq)} + Zn_{(s)} \longrightarrow [Zn(CN)_4]^{2-}_{(aq)} + 2Au_{(s)}$.

Gold is leached with a dilute solution of $NaCN$ in the presence of air (For O_2) from which the metal is obtained later by replacement.

19. Define the following with an example of each :

(a) Polysaccharides

(b) Denatured protein

(c) Essential amino acids

Ans. (a) Polysaccharides : These are the saccharides containing large number monosaccharides units joined together by glycosidic linkage. eg:- starch

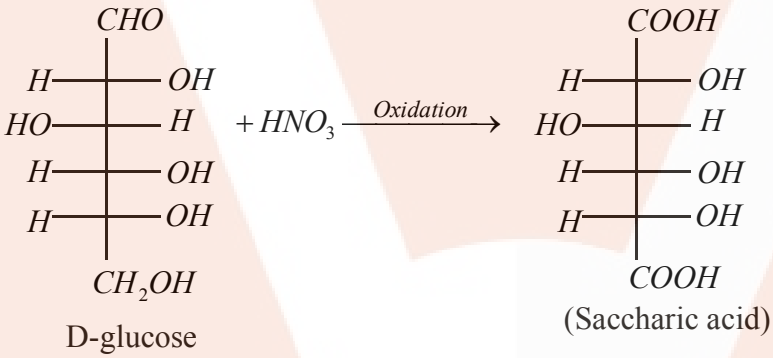
(b) Denatured protein : Denatured protein are the protein is when subjected to physical change like change in temperature or chemical change like pH, the hydrogen bonds are disturbed and loses its biological activity. eg:- The coagulation of egg white on boiling.

(c) Essential amino acids : The amino acids which cannot be synthesised in the body and must be obtained from diet are known as essential amino acids.eg:- Histidine, Valine etc.

OR

(a) Write the product when D-glucose reacts with conc. HNO_3

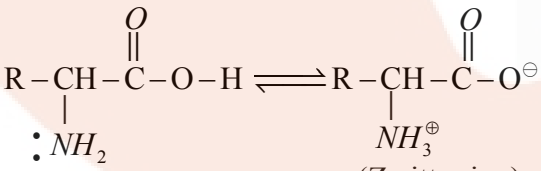
Ans. D-glucose + HNO_3 ⟶ ??



D-glucose (Saccharic acid)

(b) Amino acids show amphoteric behaviour. Why?

Ans. As amino acid contains both acidic and basic group present into them. i.e. COOH and NH_2 in the same molecule can lose a proton and amino group can accept a proton, giving rise to dipolar ion known as zwitter ion.



(Zwitter ion)

Hence, shows amphoteric nature.

(c) Write one difference between α -helix and β -pleated structures of proteins.

Ans. α -helix : It has a polypeptide chain which forms all possible hydrogen bonds twisting it into a right handed screw. (helix)

β -pleated : It has peptide chain which are stretched out to nearly maximum extension and then laid side by side which are held by intermolecular hydrogen bonds.

20. A first order reaction is 50% completed in 40 minutes at 300 K and in 20 minutes at 320 K. Calculate the activation energy of the reaction.
(Given: log 2 = 0.3010, log 4 = 0.6021, R = 8.314 JK^{-1} mol^{-1})

Ans. $T_2 = 320\,K \qquad K_2 = \dfrac{0.693}{20}$

$T_1 = 300\,K \qquad K_1 = \dfrac{0.693}{40}$

$$\log \frac{K_2}{K_1} = \frac{E_a}{2.303\,R}\left(\frac{T_2 - T_1}{T_1 T_2}\right)$$

$$\log \frac{\frac{0.693}{20}}{\frac{0.693}{40}} = \frac{Ea}{2.303 \times 8.314}\left(\frac{320-300}{320\times 300}\right)$$

$$\log\left(\frac{40}{20}\right) = \frac{Ea}{2.303 \times 8.314}\left(\frac{20}{320\times 300}\right)$$

$$1.6021 - 1.3010 = \frac{Ea}{2.303 \times 8.314}\left(\frac{20}{320\times 300}\right)$$

$$= \frac{0.3010 \times 2.303 \times 8.314 \times 320 \times 300}{20} = Ea$$

$$= 27764\,J$$

$$= 27.76\,KJ$$

21. (a) Why is bithional added to soap?

Ans. Bithinol is added to medicated soap, to reduce the odour produced by bacterial decomposition of organic matter on the skin.

(b) What is tincture of iodine ? Write its one use.

Ans. Tincture iodine is 2-3% iodine of alcohol water. It is used as antiseptic.

(c) Among the following, which one acts as a food preservative ?

Aspartame, Aspirin, Sodium Benzoate, Paracetamol

Ans. Sodium Benzoate - Food preservative.

22. What happens when

(a) a freshly prepared precipitate of $Fe(OH)_3$ is shaken with a small amount of $FeCl_3$ solution?

(b) persistent dialysis of a colloidal solution is carried out?

(c) an emulsion is centrifuged ?

Ans. (a) Colloidal dispersion of $Fe(OH)_3$ is formed this process is called peptization.

(b) On persistent dialysis a colloidal dispersion gets coagulated.

(c) On centrifugation of emulsion, separation of the two liquids will take place.

23. Shyam went to a grocery shop to purchase some food items. The shopkeeper packed all the items in polythene bags and gave them to Shyam. But Shyam refused to accept the polythene bags and asked the shopkeeper to pack the items in paper bags. He informed the shopkeeper about the heavy penalty imposed by the government for using polythene bags. The shopkeeper promised that he would use paper bags in future in place of polythene bags.

Answer the following :

(a) Write the values (at least two) shown by Shyam.

Ans. Shyam is a responsible citizen and has moral values.

(b) Write one structural difference between low-density polythene and high-density polythene.

Ans. LDPE is branched.

HDPE is linear.

(c) Why did Shyam refuse to accept the items in polythene bags ?

Ans. Polythene is a non-biodegradable polymer and it will accumulate as land fills or if burnt will cause air pollution.

(d) What is a biodegradable polymer ? Give an example.

Ans. Biodegradable polymers are the polymers which are degraded by micro organism within a suitable period so that biodegradable polymers and their degraded products do not cause any serious affects on the environment. eg:- (a) PHBV (b) Dextron (c) Nylon-2-nylon-6

24. (a) Write the cell reaction and calculate the e.m.f. of the following cell at 298 K.

$$Sn(s)\,|\,Sn^{2+}(0.004\,M)\,||\,H^{+}(0.020\,M)\,|\,H_2(g)(1\,\text{bar})\,|\,Pt(s)$$

$(\text{Given}: E^0_{Sn^{2+}/Sn} = -0.14\,V)$

Ans. **Cell reaction : -**

At anode :

$Sn \rightarrow Sn^{2+} + 2e$ (Ox)

$(s)\quad (aq)$

At cathode : -

$2H^+ + 2e^- \rightarrow H_2$ (Red)

$(aq)\qquad (g)$

$Sn + 2H^+ \rightarrow Sn^{2+} + H_2$ (redox)

$E^0_{cell} = E_{SHE} - E_{RHE}$

$= 0.0 - (-0.14)$

$= 0.14V$

$$E = E^0_{cell} - \frac{0.0591}{4}\log\frac{[Sn^{2+}]\left(P_{H_2}\right)}{\left[H^+\right]^2}$$

$$= 0.14 - \frac{0.0591}{2}\log\frac{0.004\times 1}{(0.02)^2}$$

$$= 0.14 - 0.029\log\frac{4\times 10^{-3}}{2\times 2\times 10^{-4}}$$

$$= 0.14 - 0.029\log 10$$

$$\boxed{E_{cell} = 0.111V}$$

(b) Give reasons:

(i) On the basis of E^0 values, O_2 gas should be liberated at anode but it is Cl_2 gas which is liberated in the electrolysis of aqueous NaCl.

(ii) Conductivity of CH_3COOH decreases on dilution.

Ans. (i) The standard reduction potential of water is slightly less and therefore it has slightly more chance of getting oxidised. However in concentrated souttion of NaCl, oxidation of chloride ions is prefered than water at anode. The unexpected result in due higher voltage required for electrolysis due to over voltage.

(ii) The number of ions furnished by an electrolyte depends upon degree of dissciation with increase in dilution the degree of dissociation increases as a result molar conduction of acetic and increaes with dilution.

OR

(a) For the reaction

$$2AgCl(s)+H_2(g)(1\text{atm})\longrightarrow 2Ag(s)+2H^+(0.1M)+2Cl^-(0.1M),$$

$\Delta G^0=-43600J$ at $25°C$.

Calculate the e.m.f. of the cell.

[log $10^{-n}=-n$]

Ans. $\Delta G^o=-nFE^o$

$$-43600=-2\times 96500\times E^o$$

$$E^o=\frac{43600}{2\times 96500}=0.23V$$

$$E=E^0_{cell}-\frac{0.0591}{2}\log\frac{\left[H^+\right]^2\left[Cl^-\right]^2}{\left(P_{H_2}\right)}$$

$$=0.23-\frac{0.0591}{2}\log(0.1)^2(0.1)^2$$

$$E_{cell}=0.23-0.029\log\left(10^{-4}\right)$$

$$=0.23+(0.029\times 4)$$

$$\boxed{E_{cell}=0.3482V}$$

(b) Define fuel cell and write its two advantages.

Ans. These are voltaic cells in which the reactants are continously supplied to the electrodes. There are designed to convert the energy from the combustion of fuel directly into elelectrical energy.

Advantage : -

(1) Fuel cell works with an efficiency of 60 to 70 %

(2) These are no objectionable by products and therefore, its a pollution free source of energy.

25. (a) Write the reactions involved in the following :

(i) Hofmann bromamide degradation reaction

(ii) Diazotisation

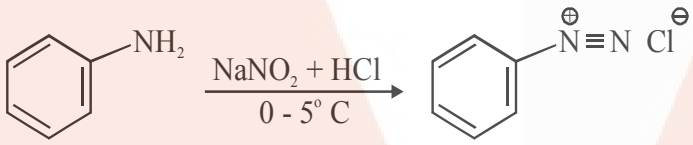
(iii) Gabriel phthalamide synthesis

Ans. (i)

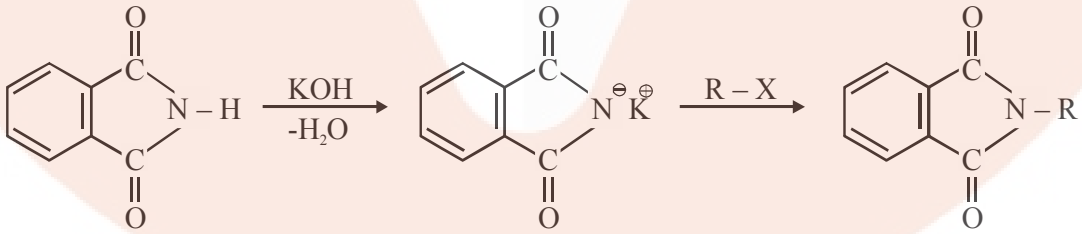
$$R - CH_2 - \underset{\underset{O}{\|}}{C} - NH_2 + 4\,NaOH + Br_2 \longrightarrow R - CH_2 - NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$$

$$Ch_3 - CH_2 - \underset{\underset{O}{\|}}{C} - NH_2 + 4NaOH + 2NaBr + 2H_2O \longrightarrow CH_3 - CH_2 - NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$$

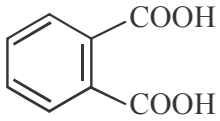
(ii)



(iii)



$$\xrightarrow{H^+/H_2O} R - NH_2 + \text{phthalic acid}$$



(b) Give reasons :

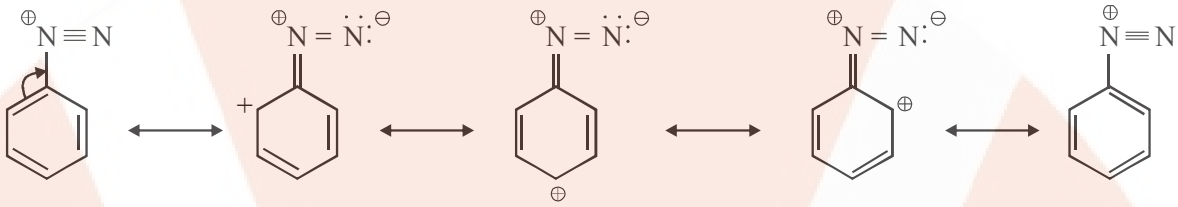
(i) $(CH_3)_2NH$ is more basic than $(CH_3)_3N$ in an aqueous solution.

(ii) Aromatic diazonium salts are more stable than aliphatic diazonium salts.

Ans. (i) Tertiary ammonium ion is less hydrated than secondary ammonium ion, thus teriary amines have less tendency to form ammonium ion and consequently they are least basic.

As a consequences of combined effects of inductive effect and solvation. Secondary amines are the strongest among amines.

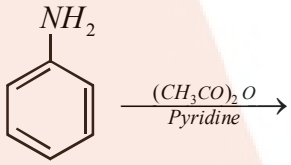
(ii) Aromatic diazonium salts are stable due to the dispersed of positive charge over the benzene ring

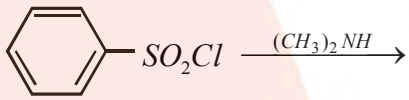


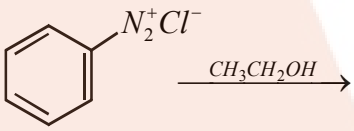
Dispersal of charge is not possible in aliphatic diazonium salts.

(OR)

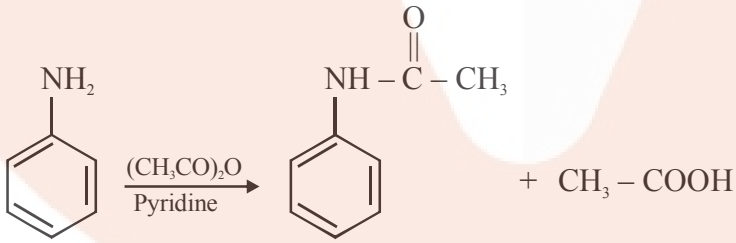
(a) Write the structures of the main products of the following reactions:

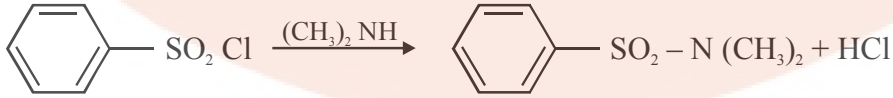
(i) 

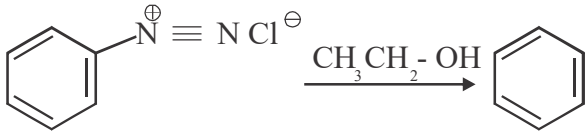
(ii) 

(iii) 

Ans. (i)

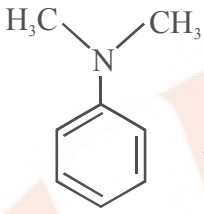


(ii) 

(iii) 

(b) Give a simple chemical test to distinguish between Aniline and N,N-dimethylaniline.

Ans.



+ $CHCl_3$ + KOH ⟶ No reaction

Carbylamine test can be used to distinguish.

(c) Arrange the following in the increasing order of their pK_b values:
$C_6H_5NH_2$, $C_2H_5NH_2$, $C_6H_5NHCH_3$

Ans. $C_2H_5NH_2 < C_6H_5NH_2 < C_6H_5NHCH_3$

26. Give reasons:

(i) H_3PO_3 undergoes disproportionation reaction but H_3PO_4 does not.

(ii) When Cl_2 reacts with excess of F_2. ClF_3 is formed and not FCl_3.

(iii) Dioxygen is a gas while Sulphur is a solid at room temperature.

Ans. (i) H_3PO_3 : Oxidation number of $P = +3$

H_3PO_4 : Oxidation number of $P = +5$

In H_3PO_4 oxidation number of polyphorous is $+5$

and H_3PO_3 oxidation number of phosphorous is $+3$

Therefore H_3PO_4 can undergo only reduction whereas H_3PO_3 can undergo oxidation as well as reduction.

(ii) Fluorine can exist only in -1 oxidation state whereas chlorine can show positive oxidation states when combined with more electronegative atom.

In ClF_3 oxidation number of Cl is $+3$ which is possible

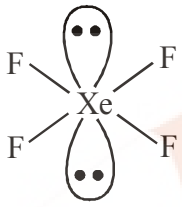
(iii) In oxygen molecule, there is $p\pi - p\pi$ overlap between two oxygen atoms forming double bond. The intermolecular forces in oxygen are weak Vander Waal's forces and therefore oxygen exists as a gas on the other hand, the S are linked by single bonds and form polyatomic complex molecules. Hence sulphur in a solid.

(b) Draw the structures of the following.

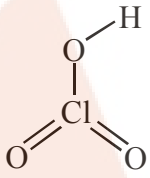
(i) XeF_4

(ii) $HClO_3$

Ans. (i)



(ii)



(OR)

Q.26 (a) When concentrated sulphuric acid was added to an unknown salt present in a test tube a brown gas (A) was envolved. This gas intensified when copper turnings were added to this test tube. On cooling, the gas (A) changed into a colourless solid (B).

(i) Identify (A) and (B)

(ii) Write the structures of (A) and (B)

(iii) Why does gas (A) change to solid on cooling.

Ans. (i) NO_2

(ii) N_2O_4

(iii) NO_2 is an odd electron species and hence it dimerizes to give N_2O_4 on cooling.

(b) Arrange the following in the decreasing order of their reducting character:

HF, HCl, HBr, HI

Ans. $HI > HBr > HCl > HI$

(c) Complete the following reaction:

$XeF_4 + SbF_5 \longrightarrow$

Ans.

$$XeF_4 + SbF_5 \downarrow$$

$$[XeF_3]^{\oplus}[SbF_6]^{-}$$