PRAGANYA PRAKASHAN

Bihar Board Class-12th

CHEMISTRY

Model Paper-5

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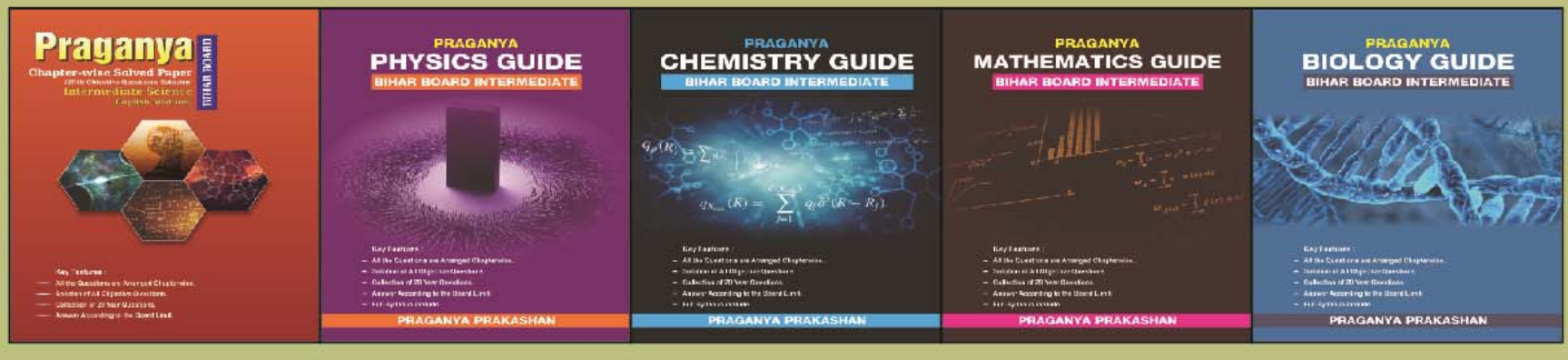

Praganya Prakashan

126, Sector 6, Vidhyadhar Nagar, Jaipur - 302039

Mob: 9001005245

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Chemistry Model Paper 5

Section A

Objective Type Questions

In the following Question Nos. 1 to 35 there is only one correct answer against each question. For each question, mark the correct option on the answer sheet. $35 \times 1 = 35$

MCQ 1.1

The total number of identical spheres required in cubic close packing arrangement of a unit cell is

(a) 6 (b) 8

(c) 12 (d) 14

Ans (d) 14

EXPLANATION :

$ccp = fcc$ has 14 spheres (8 for corners and 6 for face centres).

MCQ 1.2

Cells present in a cube-shaped ideal crystal of NaCl of mass 1.00 g are [Atomic masses : Na = 23, Cl = 35.5]

(a) 5.14×10^{21} unit cells (b) 1.28×10^{21} unit cells

(c) 1.71×10^{21} unit cells (d) 2.57×10^{21} unit cells

Ans (d) 2.57×10^{21} unit cells

EXPLANATION :

Since in NaCl type of structure 4 formula units form a cell. Number of formulas in cube shaped crystals.

$$= \frac{1.0}{58.5} \times 6.02 \times 10^{23} = 1.029 \times 10^{22}$$

Hence, $$\text{Unit cells} = \frac{1.0 \times 6.02 \times 10^{23}}{58.5 \times 4}$$

$$= 2.57 \times 10^{21} \text{ unit cells}$$

MCQ 1.3

If 2 gm of NaOH is present in 200 ml of its solution, its molarity will be

(a) 0.25 (b) 0.5

(c) 5 (d) 10

Ans (a) 0.25

EXPLANATION :

We know that

$$\text{Molarity, } C = \frac{\text{moles of solution}\,(n)}{\text{volume of solution}\,V(\text{mL})}$$

$$\text{And } n = \frac{w(\text{moles of solute})}{m(\text{molar mass of solute})}$$

$$\text{Molar mass of NaOH} = 23 + 16 + 1 = 40$$

$$\text{Or } C = \frac{W_B}{M_B} \times \frac{1000}{V(\text{in ml})}$$

$$\text{Hence, } C = \frac{2 \times 1000}{40 \times 200}$$

$$\text{Molarity of solution} = 0.25\,\text{M}$$

MCQ 1.4

The normality of 10% (weight/volume) acetic acid is

(a) 1 N (b) 10 N

(c) 1.7 N (d) 0.83 N

Ans (c) 1.7 N

EXPLANATION :

As we know that,

$$\text{Mol. mass of } CH_3COOH = 60$$

$$\text{Normality} = \frac{10 \times 1000}{60 \times 100} = 1.7$$

MCQ 1.5

The relationship between osmotic pressure at 273 K when 10g glucose(P_1), 10g urea (P_2), and 10g sucrose (P_3) are dissolved in 250 ml of water is

(a) $P_1 > P_2 > P_3$ (b) $P_3 > P_1 > P_2$

(c) $P_2 > P_1 > P_3$ (d) $P_2 > P_3 > P_1$

Ans (c) $P_2 > P_1 > P_3$

EXPLANATION :

$$\text{Moles of glucose} = \frac{10}{180} = 0.05$$

$$\text{Urea} = \frac{10}{60} = 0.16$$

$$\text{Sucrose} = \frac{10}{342} = 0.029$$

Hence osmotic pressure $P_2 > P_1 > P_3 (\pi \propto c)$

MCQ 1.6

If 96500 coulomb of electricity is passed through $CuSO_4$ solution, it will liberate

(a) 63.5 g Cu (b) 31.76 g Cu

(c) 96500 g Cu (d) 100 g Cu

Ans :(b) 31.76 g Cu

EXPLANATION :

As we know that,

Molar mass of copper = 63.5

As Copper (Cu) contain (+)2 charge in $CuSO_4$, it requires $2\text{F}\,(= 2 \times 96500\,\text{C})$ charge to give one mole i.e. 63.5 g of copper. Thus on giving 96500 C of electricity, we get $63.5/2 = 31.76\,\text{g}$ of copper.

Hence, (b) is the correct option.

MCQ 1.7

For the galvanic cell

$Zn|Zn^{2+}(0.1M)\|Cu^{2+}(1.0M)|Cu$ the cell potential increase if

(a) $[Zn^{2+}]$ is increased

(b) $[Cu^{2+}]$ is increased

(c) $[Cu^{2+}]$ is decreased

(d) surface area of anode is increased

Ans :(b) $[Cu^{2+}]$ is increased

EXPLANATION :

For the given cell

$$E_{\text{cell}} = E^{\circ}{}_{\text{cell}} - \frac{0.059\text{V}}{2}\log\frac{[\text{Zn}^{+}(\text{aq})]}{[\text{Cu}^{+}(\text{aq})]}$$

The cell potential will decreases with increase in $[\text{Zn}^{2+}(\text{aq})]$ and will increases with increase in $[\text{Cu}^{2+}(\text{aq})]$ i.e. (c)

MCQ 1.8

Which of the following solutions has the highest equivalent conductance?

(a) 0.01 M NaCl (b) 0.050 M NaCl

(c) 0.005 M NaCl (d) 0.02 M NaCl

Ans :(c) 0.005 M NaCl

EXPLANATION :

With dilution the equivalent conductance increases. So 0.005 M NaCl having highest equivalent conductance.

MCQ 1.9

When one ampere current is passed through a Cu wire for 10 seconds, the number of electrons passing through it is

(a) $1.6 \times 10^{+19}$ (b) $1 \times 10^{+35}$

(c) $1 \times 10^{+16}$ (d) 6.69×10^{19}

Ans :(d) 6.69×10^{19}

EXPLANATION :

As we know that,

$$96500 \text{ coulombs} = 6.023 \times 10^{23} \text{ electrons.}$$

$$10 \text{ coulombs} = \frac{6.23 \times 10^{23} \times 10}{96500} = 6.69 \times 10^{19}$$

MCQ 1.10

The order of reaction $\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \xrightarrow{\text{sunlight}} 2\text{HCl}$ in water is

(a) 3 (b) 2

(c) 1 (d) 0

Ans :(d) 0

EXPLANATION :

Reaction between hydrogen and chlorine under the influence of sunlight is the photochemical combination of hydrogen and chlorine. The reaction does not take place in the dark. This is a zero-order reaction as the rate is independent of concentration of both hydrogen and chlorine goes in a closed glass vessel containing calculated amount of water which can dissolve the product $\text{H}_2 + \text{Cl} \rightarrow 2\text{HCl}$.

MCQ 1.11

Units of rate constant of first and zero order reactions in terms of molarity M unit are respectively

(a) $\text{sec}^{-1}, \text{M}\,\text{sec}^{-1}$ (b) $\text{sec}^{-1}, \text{M}$

(c) $\text{M}\,\text{sec}^{-1}, \text{sec}^{-1}$ (d) $\text{M}, \text{sec}^{-1}$

Ans :(a) $\text{sec}^{-1}, \text{M}\,\text{sec}^{-1}$

EXPLANATION :

For a zero order reaction.

$$\text{Rate} = k[A]^{\circ}$$

i.e. $$\text{Rate} = k$$

Hence, $$\text{Unit of } k = \text{M}.\,\text{sec}^{-1}$$

For a first order reaction.

$$\text{Rate} = k[A]$$

$$k = \text{M}.\,\text{sec}^{-1}/\text{M} = \text{sec}^{-1}$$

MCQ 1.12

In the reaction $2A + B \longrightarrow A_2B$, if the concentration of A is doubled and that of B is halved, then the rate of the reaction will

(a) increase 2 times (b) increase 4 times

(c) decrease 2 times (d) remain the same

Ans :(a) increase 2 times

EXPLANATION :

$$2A + B \longrightarrow A_2B$$

$$r_1 = k[A]^2[B]$$

When, $$[A] = [2A], [B] = \left[\frac{B}{2}\right]$$

$$r_2 = k[2A]^2\left[\frac{B}{2}\right]$$

$$= k4A^2\frac{B}{2}$$

$$= K2A^2B$$

$$= 2r_1 \qquad (\because\ r_1 = kA^2B)$$

Hence, Rate of reaction is increased two times.

MCQ 1.13

A catalyst is a substance which

(a) Increases the equilibrium concentration of the product

(b) Changes the equilibrium constant of the reaction

(c) Shortens the time to reach equilibrium

(d) Supplies energy to the reaction

Ans :(c) Shortens the time to reach equilibrium

EXPLANATION :

A catalyst is a substance that speeds up a chemical reaction, but is not consumed by the reaction, hence a catalyst can be recovered chemically unchanged at the end of the reaction it has been used to speed up or catalyse the reaction.

MCQ 1.14

Which of the following is not a colloid?

(a) Chlorophyll (b) Smoke

(c) Ruby glass (d) Milk

Ans :(a) Chlorophyll

EXPLANATION :

Chlorophyll. Smoke is an example of solidgas colloid system
Ruby glass is an example of solid-solid colloid system.
Milk is an liquid-liquid colloid system.

MCQ 1.15

Bronze is a mixture of

(a) Pb+Sn (b) Cu+Sn

(c) Cu+Zn (d) Pb+Zn

Ans :(b) Cu+Sn

EXPLANATION :
Bronze is an alloy consisting primarily of primarily of copper (Cu), commonly with about 12% tin(Sn) and often with the addition of other metals (Such as aluminium manganese, nickel or zinc) and some times.
Option (b) is correct.

MCQ 1.16

Which of the following is an amorphous solid?
(a) Graphite (C)
(b) Quartz Glass (SiO_2)
(c) Chrome Alum
(d) Silicon Carbide (SiC)

Ans :(b) Quartz Glass (SiO_2)

EXPLANATION :
Quartz Glass is a mineral with the chemical formula SiO_2 and like almost all minerals, It is a amorphous solid. Because glass, by definition, is an amorphous solid. Glass does not have much internal order, thus is an amorphous.

MCQ 1.17

Sodium is a member of which group in periodic table?
(a) Group I
(b) Group II
(c) Group IV
(d) None of these

Ans :(a) Group I

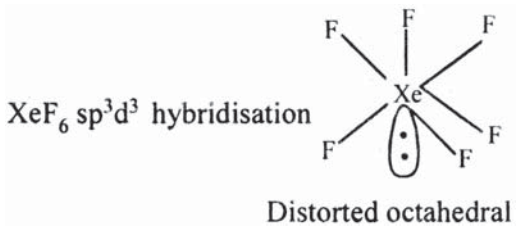
EXPLANATION :
In the periodic table, group of any element is decided by the number of electrons present in the valency shell i.e., by the electronic configuration of its outer most shell. As sodium has only one electron (in *s*-sub shell), thus it belongs to group-I.

MCQ 1.18

The structure of XeF_6 is
(a) distorted octahedral
(b) pyramidal
(c) tetrahedral
(d) none of the above

Ans :(a) distorted octahedral

EXPLANATION :
sp^3d^3 hybridization will give pentagonal bipyramid geometry with one trans position occupied by a lone pair and shape of the molecule will be distorted octahedral.



MCQ 1.19

During its reactions, ozone
(a) can only combine with hydrogen atoms
(b) accepts electrons
(c) loses electrons
(d) shows the role of electrons to be irrelevant

Ans :(a) can only combine with hydrogen atoms

EXPLANATION :
Since ozone can easily lose oxygen atom (nascent oxygen), it acts as a powerful oxidising agent, and hence reacts with hydrogen atoms.

MCQ 1.20

PCl_3 reacts with water to form
(a) PH_3
(b) H_3PO_3, HCl
(c) $POCl_3$
(d) H_3PO_4

Ans :(b) H_3PO_3, HCl

EXPLANATION :
Phosphorus trichloride (PCl_3) is used industrially in the production of organophosphorus compounds that are used as flame retardants and pesticides. PCl_3 reacts vigorously with water to form phosphric acid and HCl.
$PCl_3(l) + 3H_2O(l) \rightarrow H_3PO_3(aq) + 3HCl(g)$

MCQ 1.21

Which of the following is a nitric acid anhydride?
(a) NO
(b) NO_2
(c) N_2O_5
(d) N_2O_3

Ans :(c) N_2O_5

EXPLANATION :
The anhydride of an acid is the acidic oxide which on hydration form the acid. N_2O_5 dissolves in water to gives nitric acid.
$N_2O_5 + H_2O \rightarrow 2HNO_3$

MCQ 1.22

Which one of the following elements shows maximum number of different oxidation states in its compounds?
(a) Eu
(b) La
(c) Ge
(d)Am

Ans :(d) Am

EXPLANATION :
We know that lanthanides Eu, La, Gd shows +2, +3, +3 and +3 oxidation states respectively only. while actinides, Am shows +2, +3, +4, +5 and +6 oxidation state.
Therefore American (Am) has maximum number of oxidation state.

MCQ 1.23

Mercuric chloride reacts with ammonia gas and forms white precipitate. The molecular formula of white precipitate is –
(a) $HCl_2 \cdot 2NH_3$
(b) $Hg(NH_3)_2Cl_2$
(c) $Hg(NH_2)Cl_2$
(d) $Hg(NH_2)Cl$

Ans :(b) $Hg(NH_3)_2Cl_2$

EXPLANATION :
Mercury(II) chloride when reacted with ammonia gas or ammonium chloride produces a fusible white precipitate of diammine mercury(II) chloride.

$$HgCl_2 + 2NH_3(g) \longrightarrow \underset{\text{fusible white precipitate}}{Hg(NH_3)_2Cl_2}$$

MCQ 1.24

Which kind of isomerism is exhibited by octahedral $Co(NH_3)_4Br_2Cl$?

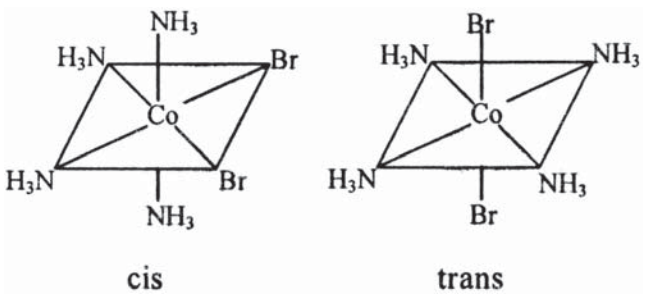
(a) Geometrical and Ionization
(b) Geometrical and Optical
(c) Optical and Ionization
(d) Geometrical only

Ans :(a) Geometrical and Ionization.

EXPLANATION :

$Co(NH_3)_4Br_2Cl$ will show both geometrical and ionization isomerism.

$[Co(NH_3)_4Br_2]Cl$ and $[Co(NH_3)_4BrCl]Br$ are ionization isomers and geometrical isomers are



MCQ 1.25

Which one of the following complexes will have four different isomers?

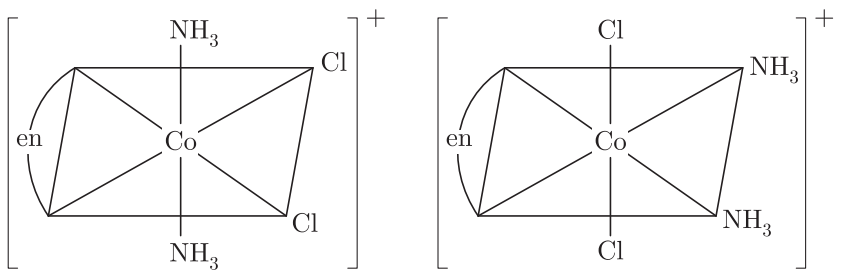
(a) $[Co(en)_2Cl_2]Cl$ (b) $[Co(en)(NH_3)Cl_2]Cl$
(c) $[Co(PPH_3)_2Cl_2]Cl$ (d) $[Co(en)_3]Cl_3$

Ans :(b) $[Co(en)(NH_3)Cl_2]Cl$

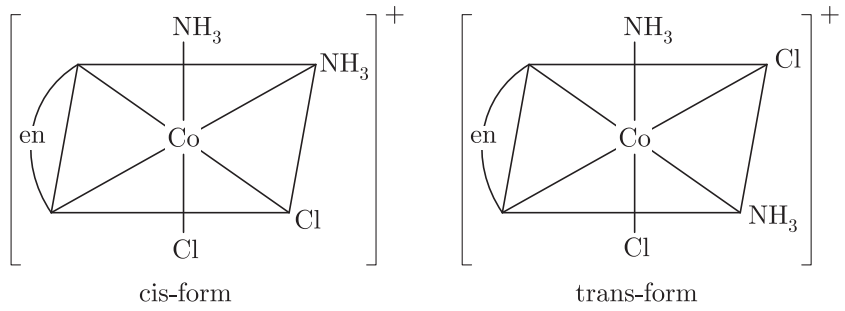
EXPLANATION :

Complex $[Co(en)(NH_3)_2Cl_2]Cl$ will have four different isomers.

1. Geometrical isomers



2. Optical isomers



MCQ 1.26

Which of the following is the example of Friedal Craft Reaction:

(a) $C_6H_6 + CH_3CH_2Cl \xrightarrow{AlCl_3} C_6H_5C_2H_5 + HCl$
(b) $C_6H_5OH + CH_3CH_2Cl \xrightarrow{AlCl} C_6H_5C_2H_5 + HOCl$
(c) $C_6H_5Cl + CH_3CH_2Cl \xrightarrow{[AlCl_3]} C_6H_5C_2H_5 + Cl_2$
(d) $C_6H_5CH_3 + CH_3CH_2Cl \xrightarrow{[AlCl_3]} C_6H_5C_2H_5 + CH_3Cl$

Ans :(a)

$C_6H_6 + CH_3CH_2Cl \xrightarrow{AlCl_3} C_6H_5C_2H_5 + HCl$

EXPLANATION :

Friedel-Craft's reaction is mainly applied on benzene.

$C_6H_6 + CH_3CH_2Cl \xrightarrow{AlCl_3} C_6H_5C_2H_5 + HCl$

MCQ 1.27

Which of the following on reduction with $LiAlH_4$ give Ethyl alcohol (C_2H_5OH)?

(a) $(CH_3CO)_2O$ (b) CH_3COCl
(c) CH_3CONH_2 (d) $CH_3COOC_2H_5$

Ans :(c) CH_3CONH_2

EXPLANATION :

All thus, given option can be reduces by $LiAlH_4$ to give C_2H_5OH except CH_3CONH_2 (amide). CH_3CONH_2 give amine $(CH_3CH_2NH_2)$ on reduction. Lithium Aluminum hydride is very effective for the reduction of aldehydes ketones acid chlorides, acid-anhydrides, esters. to alcohols. But will not reduce amids.

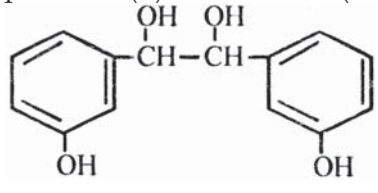
$$R-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow[(ii)\ H_3O^+]{(i)\ LiAlH_4} R-CH_2-OH$$

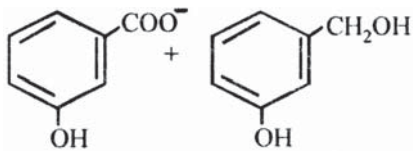
$$R-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow[\text{Oxygen}]{\text{Remove the}} R-C-OH \xrightarrow[(-)\,\text{bonds}]{\text{Add two}} \underset{R}{\overset{H}{\overset{|}{}}}\!\!>C\!\!<\underset{OH}{\overset{H}{\overset{|}{}}}$$

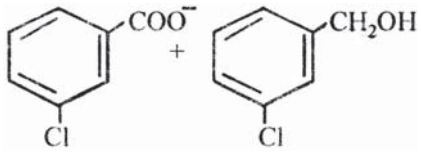
$(=CH_3\cdot CH_2\cdot OH)$

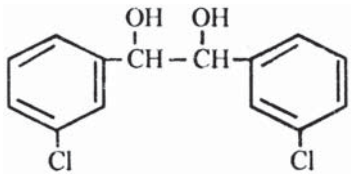
MCQ 1.28

When m-chlorobenzaldehyde is treated with 50% KOH solution, the producer(s) obtained is (are)

(a) 

(b) 

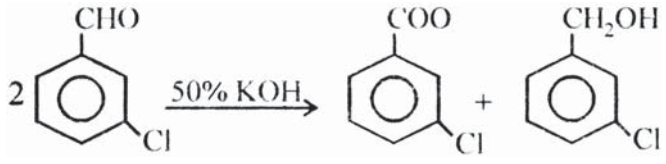
(c) 

(d) 

Ans :(c)

EXPLANATION :

It is simple Cannizzro reaction.



MCQ 1.29

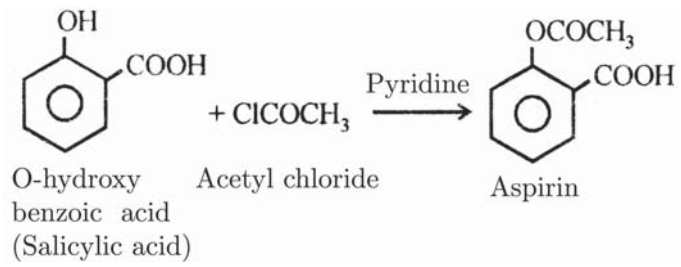
Aspirin is an acetylation product of

(a) o-hydroxybenzoic acid (b) o-dihydroxybenzene

(c) m-hydroxybenzoic acid (d) p-dihydroxybenzene

Ans :(a) o-hydroxybenzoic acid

EXPLANATION :



MCQ 1.30

Benzaldehyde reacts with ethanoic KCN to give

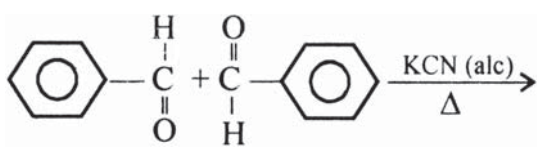
(a) $C_6H_5CHOHCN$ (b) $C_6H_5CHOHCOC_6H_5$

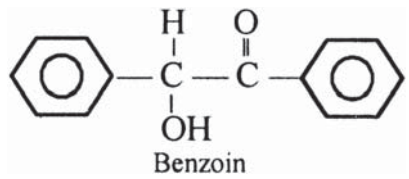
(c) $C_6H_5CHOHCOOH$ (d) $C_6H_5CHOHCHOHC_6H_5$

Ans :(b) $C_6H_5CHOHCOC_6H_5$

EXPLANATION :

When benzaldehyde is refluxed with aqueous alcoholic potassium cyanide, two molecules of benzaldehyde condense together to form benzoin





MCQ 1.31

When ethylamine react with sodium metal, the gas evolved is:

(a) H_2 (b) C_2H_5

(c) N_2 (d) NH_3

Ans :(a) H_2

EXPLANATION :

When ethylamine is heated with sodium metal, then hydrogen gas is evolved.

$2C_2H_5NH_2 + 2Na \longrightarrow 2C_2H_5NHN_a + H_2\uparrow$

Hence, option (a) is correct.

MCQ 1.32

Aniline reacts with Acetaldehyde to form:

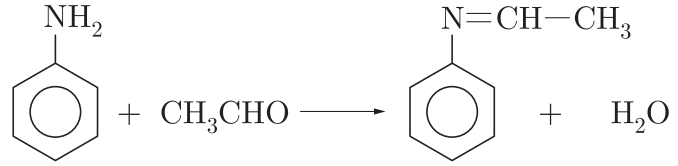
(a) Carbylamines (b) Nitrobenzene

(c) Imine (d) Schiff's base

Ans :(d) Schiff's base

EXPLANATION :

Aniline reacts with acetaldehyde to form Schiff's base.



Anil or Schiff's base

Water is eliminated in the reaction which is acid-catalyzed and reversible in the same sense as acetal formation.

MCQ 1.33

Which is able to form Zwitterion?

(a) CH_3NO_2 (b) CH_3COOH

(c) $CH_3CH_2NH_2$ (d) H_2NCH_2COOH

Ans :(d) H_2NCH_2COOH

EXPLANATION :

At low or acidic pH values, the hydrogen ions add to the carboxyl group, making it neutral. This gives the amino acid a net charge +1. At high, or basic, pH values, a hydrogen ion on N is removed by the excess base, neutralizing the amino group.

MCQ 1.34

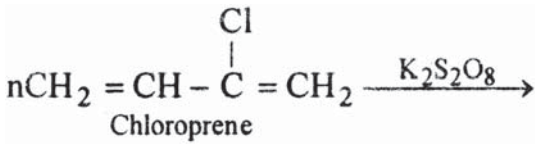
Which one of the following monomers gives the polymer neoprene on polymerization?

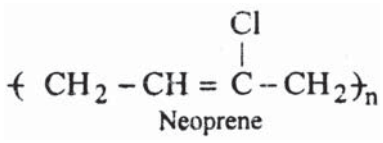
(a) $CF_2 = CF_2$ (b) $CH_2 = CHCl$

(c) $CCl_2 = CCl_2$ (d) $CH_2 = \overset{Cl}{\underset{|}{C}} - CH = CH_2$

Ans :(d) $CH_2 = \overset{Cl}{\underset{|}{C}} - CH = CH_2$

EXPLANATION :





MCQ 1.35

Which one of the following is employed as Antihistamine?

(a) Chloramphenicol (b) Diphenyl hydramine

(c) Norothindrone (d) Omeprazole

Ans :(b) Diphenyl hydramine

EXPLANATION :

Diphenyl hydramine also known as (Banadry) is an antihistamine.

Section B (Non-objective Type)

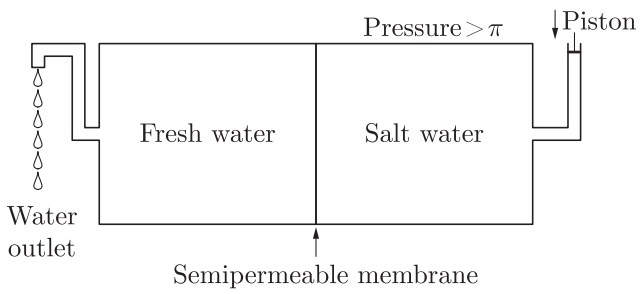
In Section-B, there are 15 short answer type questions (each carrying 2 marks) out of which any 10 questions are to be answered. A part from this there are 3 long answer type questions (each carrying 5 marks). Each question has an alternative option.

QUE 1.1

What is reverse osmosis?

Ans :

Reverse osmosis : The direction of osmosis can be reversed if a pressure larger than the osmotic pressure is applied to the solution side. The pure solvent flows out of the solution through semipermeable membrane. towards the pure solvent (or less concentrated solution) side. This phenomenon is called **reverse osmosis**. This method is used in desalination to get salt free-water from sea water as shown in figure.



The pressure required for the reverse osmosis is quite high. A workable porous membrane is a film of cellulose acetate placed over a suitable support. Cellulose acetate is permeable to water but impermeable to impurities and ions present in sea water.

QUE 1.2

What do you mean by Faraday?

Ans :

We know that charge on one electron is equal to 1.6021×10^{-19}C
Therefore, the charge on one mole of electrons is equal to :

$$\begin{aligned} & N_A \times 1.6021 \times 10^{-19} \\ C &= 6.02 \times 10^{23} mol^{-1} \times 1.6021 \times 10^{-19} \\ C &= 96487\, C\, mol^{-1} \end{aligned}$$

For approximate calculation we use IF $\simeq 96500\, C\, mol^{-1}$. This quantity of electricity is called Faraday and is represented by the symbol F.
For the electrode reaction :

$$Al^{3+}(l) + 3e^- \rightarrow Al(s)$$

One mole of Al^{3+} required 3 mol of electrons (3F).

QUE 1.3

Define rate of reaction.

Ans :

Rate of reaction or speed of reaction is the change in concentration of a reactant or product in unit time.
For a reaction: $R \longrightarrow P$

$$\begin{aligned} \text{Rate of reaction} &= \text{Rate of disappearance of } R \\ &= \frac{\text{Decrease in Conc. of } R}{\text{Time taken}} \\ &= \frac{-\Delta [R]}{\Delta t} \\ \text{Rate of reaction} &= \text{Rate of appearance of } P \\ &= \frac{\text{Increase in Conc. of } P}{\text{Time taken}} \\ &= \frac{+\Delta [P]}{\Delta t} \end{aligned}$$

(Rate of reaction is always positive. The minus sign along with the concentration of reactants is used to show that the concentration of the reactant is decreasing i.e. ΔR is a negative so that $(-) \times (-) = +$.
The plus sign with the conc. of Product show that the conc. of the product is increasing.)
Units of rate of reaction : Concentration $time^{-1}$
or mol $L^{-1}s^{-1}$
For gaseous reactions : atm s^{-1}

QUE 1.4

Differentiate between Absorption and Adsorption.

Ans :

	Absorption	**Adsorption**
1.	It is the phenomenon in which is particles of gas and liquid distributed uniformly throughout the bulk of the solid.	It is the phenomenon in which the concentration of the particles of the gas and the liquid are more at the surface than in the bulk of the solid.
2.	Particles are distributed uniformly so it is a bulk phenomenon.	Concentration of the particles are more at the surface than in the bulk. Therefore, it is surface phenomenon.

3.	It occurs at the uniform rate.	In the beginning it occurs at the high rate and than rate decreases slowly.

QUE 1.5

What is meant by the term "Chromatography"?

Ans :

The term chromatography was originally derived from the Greek word Chroma meaning colour and graphy for writing because the method was first used for the separation of coloured substance (plant pigments) into individual components. Now this method is widely used for separation, purification, identification and characterization of the components of a mixture whether coloured or colourless.

QUE 1.6

Explain, why the valency of inert gases is zero.

Ans :

Valency of inert gases is zero due to their fully-filled outer most (valency shell) configuration As they have eight electrons (except helium), in their valency shell, they have no tendency to give or accept any electron. Thus they are inert and do not participate in chemical reactions. The electronic configuration of inert gas elements are-

1. Helium (He), $(Z=2) \rightarrow 1s^2$
2. Neon (Ne), $(Z=10) \rightarrow [\mathrm{He}], 2s^2.2p^6$
3. Argon (Ar), $(Z=18) \rightarrow [\mathrm{Ne}], 3s^2, 3p^6$
4. Krypton Kr, $(Z=36) \rightarrow [\mathrm{Ar}]\, 4s^2, 4p^6$
5. Xenon (Xe), $(Z=54) \rightarrow [\mathrm{Kr}]\, 5s^2, 5p^6$.
6. Radon (Rn), $(Z=86) \rightarrow [\mathrm{X_e}]\, 4f^{14}, 5d^{10}, 6s^2, 6p^6$

QUE 1.7

Why does the reactivity of nitrogen differ from phosphorous?

Ans :

Nitrogen exist as a diatomic molecule $(\mathrm{N} \equiv \mathrm{N})$. Due to the presence of a triple bond between the two N-atoms, the bond dissociation energy is large $(941.4\ \mathrm{kJ\ mol^{-1}})$. As a result, nitrogen is inert and unreactive in its elemental state.
While phosphorus (white or yellow) exists as a tetra atomic molecule $(\mathrm{P_4})$. Since the $\mathrm{P-P}$ single bond is much weaker $(213\ \mathrm{kJmol^{-1}})$ than $\mathrm{N} \equiv \mathrm{N}$ triple bond, therefore phosphorus is much more reactive than nitrogen.

QUE 1.8

Write the reaction of Brown ring test.

Ans :

$$\mathrm{NO_3^- + 3Fe^{2+} + 4H^+ \longrightarrow NO + 3Fe^{3+} + 2H_2O}$$

$$\mathrm{NO + \left[Fe(H_2O)_6\right]^{2+} \longrightarrow \underset{\text{(Brown)}}{\left[Fe(H_2O)_5(NO)\right]^{2+}} + H_2O}$$

QUE 1.9

Write the electronic configuration of

1. $\mathrm{Co^{2+}}(27)$
2. $\mathrm{Ce^{4+}}(58)$
3. $\mathrm{Lu^{2+}}(71)$

Ans :

1. $\mathrm{Co^{2+}}(\tau=27)\ [\mathrm{Ar}]\, 3d^7 4s^\circ$
2. $\mathrm{Ce^{4+}}(\tau=58)\ [\mathrm{Xe}]\, 4f^\circ 5d^\circ 6s^\circ$
3. $\mathrm{Lu^{4+}}(\tau=71)\ [\mathrm{Xe}]\, 4f^{14} 5d^1 6s^\circ$

QUE 1.10

Write IUPAC names of the following :

1. $\mathrm{[Cu(NH_3)_4]Cl_2}$
2. $\mathrm{K_4[Fe(CN)_6]}$

Ans :

1. $\mathrm{[Cu(NH_3)_4]Cl_2}$

$$x + 0 \times 4 + (-1) \times 2 = 0$$
$$x = 2$$

Tetraammine copper (II) chloride

2. $\mathrm{K_4[Fe(CN)_6]}$

$$1 \times 4 + x + (-1) \times 6 = 0$$
$$x = 6 - 4 \quad \boxed{x = 2}$$

Potassium hexacyano ferrtate (II)

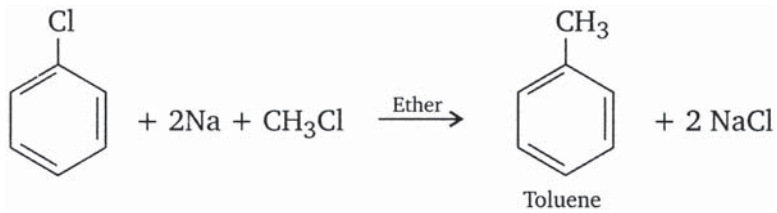
QUE 1.11

Give one example of each of the following reactions:

1. Wurtz reaction
2. Wurtz-Fitting reaction.

Ans :

1. **Wurtz Reaction :** It converts alkyl halides into alkane.
   Example :
   $\mathrm{CH_3Cl + 2Na + CH_3Cl \xrightarrow{\text{Dry ether}} 2NaCl + C_2H_6}$
2. **Wurtz-Fitting Reaction :** It converts an aryl halide and alkyl halide into the corresponding hydrocarbon.



QUE 1.12

What are tertiary alcohols?

Ans :

In tertiary alcohols, three carbon atoms are directly bonded to the carbon carrying the -OH group.

Example : $\mathrm{CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-OH}$ (2-Methylpropan-2-ol

QUE 1.13

What happens when-
Acetaldehyde is heated with bleaching powder?

Ans :

What happens when :
Acetaldehyde is heated with bleaching powder:

(a) $\mathrm{CH_3CHO + 3Cl_2 \longrightarrow CCl_3CHO + 3HCl}$

(b) $\mathrm{2CCl_3CHO + Ca(OH)_2 \longrightarrow CHCl_3 + Ca(HCOO)_2}$

or

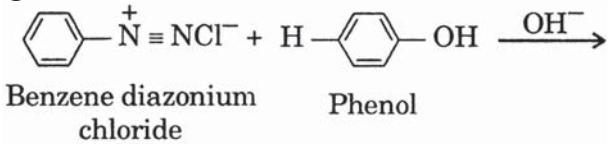
$$\underset{\text{(acetaldehyde)}}{CH_3CHO} + \underset{\text{(bleaching powder)}}{Ca(OCl_2)} \longrightarrow \underset{\text{(chloroform)}}{CHCl_3} + Ca(HCOO)_2$$

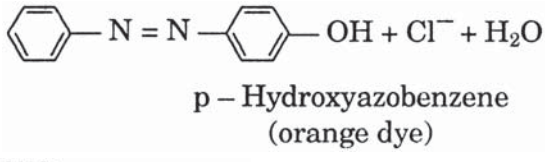
QUE 1.14

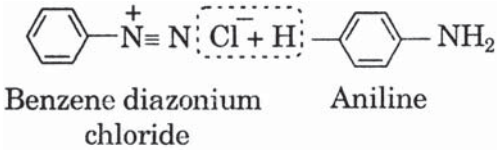
Write coupling reaction of Benzene diazonium chloride.

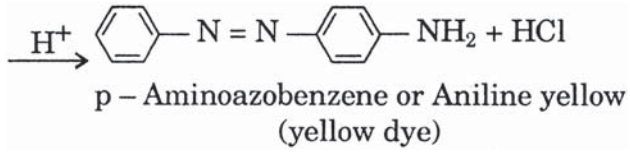
Ans :

Benzene diazonium chloride reacts with highly reactive aromatic compounds such as phenol and aniline to form coloured compounds, which are used as dyes. The aromatic rings are joined by through the $-N=N-$bond. This reaction is called coupling reaction.









QUE 1.15

2.5 g of ethanoic acid (CH_3COOH) is dissolved in 75 g of benzene. Calculate the molality of the solution.

Ans :

$$\begin{aligned}
\text{Molar mass of } CH_3COOH &= 2\times 12 + 4\times 1 + 2\times 16 \\
&= 60\ \text{g mol}^{-1} \\
\text{Moles of } CH_3COOH &= \frac{2.5\ \text{g}}{60\ \text{g mol}^{-1}} = 0.0417\ \text{mol} \\
\text{Mass of benzene} &= 75\ \text{g} \\
\text{Molality of } CH_3COOH &= \frac{\text{Moles of } CH_3COOH}{\text{Mass of benzene (in g)}} \times 1000 \\
&= \frac{0.0417\ \text{mol}}{75} \times 1000 \\
&= 0.556\ \text{m}
\end{aligned}$$

Long Answer Type Questions

Answer all the three questions :

QUE 1.1

Define rate constant of a reaction. Derive an expression for the rate constant of 1st order reaction

Ans :

According to This Law

At a given temperature the rate of a chemical reaction is directly proportional to the product of the molar concentration of the reactants.

The molar concentration of the reactant is also called active mass. Let us consider a simple reaction of the type.

$$A + B \longrightarrow 2AB$$

According to law of mass action, rate of the reaction may be written as :

$$\text{Rate} = k[A][B]$$

where, $[A]$ and $[B]$ are the molar concentrations of reactants, k is constant of proportionality and is called rate constant. The rate constant is also called velocity constant and is a measure of rate of the reaction.

Now, if concentration of each of the reactants involved in the reaction is unity, i.e. $[A] = [B] = 1$, then substituting these values in above expression, we get

$$\text{Rate of reaction} = k \times 1 \times 1 = k$$

Thus, the rate constant of a reaction at a given temperature may be defined as

rate of the reaction when the molar concentration of each of the reactants is unity.

That is why the rate constant is also called specific reaction rate..

e.g. Consider the general first order reaction

$$R \longrightarrow \text{Products}$$

Let [R] is the concentration of the reaction R and k is the rate constant for the first order reaction. For the first order reaction, the rate of the reaction is directly proportional to the concentration of the reactant R. Thus,

$$\text{Rate} = -\frac{d[R]}{dt} = k[R] \qquad ....(1)$$

This form of rate law is known as differential rate equation. Integrated form of rate low can be written as follow:

$$K = \frac{2.303}{t}\log\frac{[R]_0}{[R]}$$

where, $[R]_0$ = initial concentration.

$[R]$ = concentration at time 't'

OR QUE

The rate constant for the first order of decomposition of H_2O_2 is given by the following equation.

$$\log k = 14.34 - 1.25 \times 10^4 \text{K/T}$$

Calculate E_a for this reaction and at what temperature will its half-period be 256 minutes?

Ans :

$$\log k = 14.34 - \frac{1.25\times 10^4 \text{K}}{T} \qquad ...(1)$$

Also,
$$\log k = \log A - \frac{E_a}{2.303\,RT} \qquad ...(2)$$

On comparing (1) and (2), we have

$$-\frac{E_a}{2.303\,RT} = -\frac{1.25\times 10^4 \text{K}}{T}$$

Hence,
$$\begin{aligned} E_a &= 1.25\times 10^4 \times 8.314 \times 2.303 \\ E_a &= 103.92\ \text{kJ mol}^{-1} \times 2.303 \end{aligned}$$

$$E_a = 239.3375 \text{ kJ mol}^{-1}$$

$$k = \frac{0.693}{256} \text{minute}^{-1}$$

Now, $$k = \frac{0.693}{256} \times \frac{1}{60} = 4.51 \times 10^{-5} \text{s}^{-1}$$

From Eq. (1), $$\log k = 14.34 - \frac{1.25 \times 10^4 \text{ K}}{T}$$

$$\log 4.51 \times 10^{-5} = 14.34 - \frac{1.25 \times 10^4}{T} K$$

$$0.65 - 5.00 = 14.34 - \frac{1.25 \times 10^4}{T} \text{K}$$

$$-4.35 = 14.34 - \frac{1.25 \times 10^4}{T} \text{K}$$

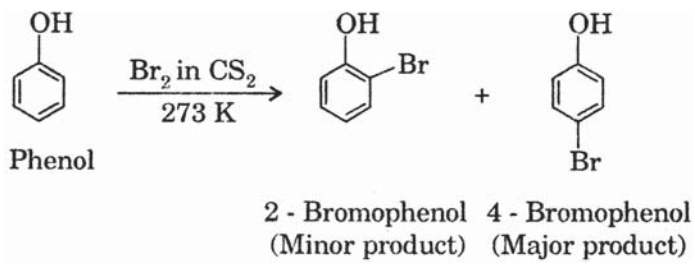
$$T = \frac{1.25 \times 10^4}{18.69} = \frac{12500}{18.69} = 668.80 \text{ K}$$

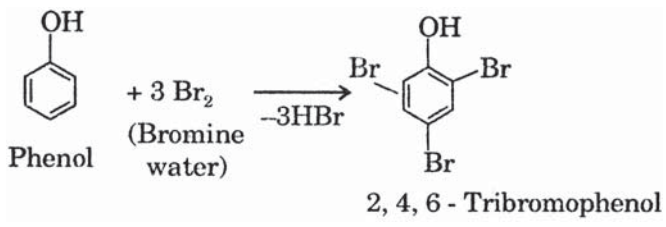
QUE 1.2

Write chemical reactions of following :
1. Halogenation of phenol
2. Kolbe's reaction of phenol

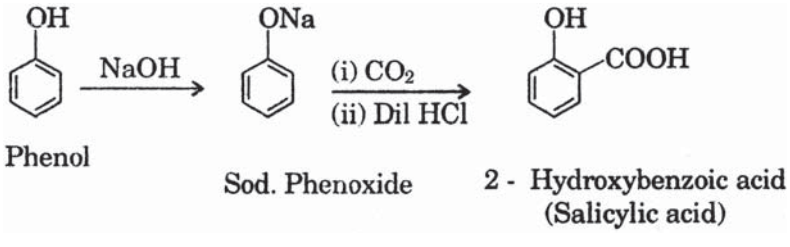
Ans :

1. Halogenation

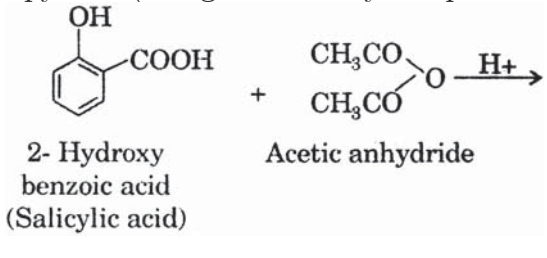


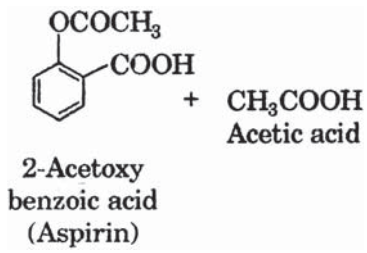


2. Kolbe's reaction : Sodium phenoxide when heated with CO_2 at 400 K and 4-7 atm. followed by acidification gives salicylic acid. This reaction is called Kolbe's reaction.



Salicylic acid is used for the manufacture of 2-Acetoxybenzoic acid (aspirin) which is an analgesic (relieved from pain) and antipyretic (bring down body temperature).



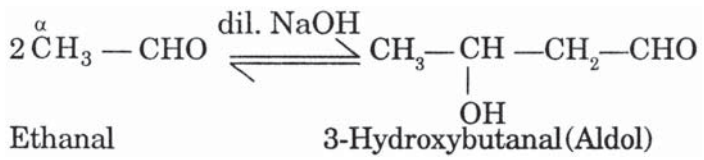


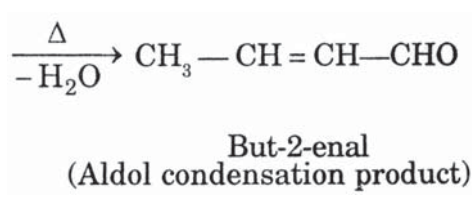
OR QUE

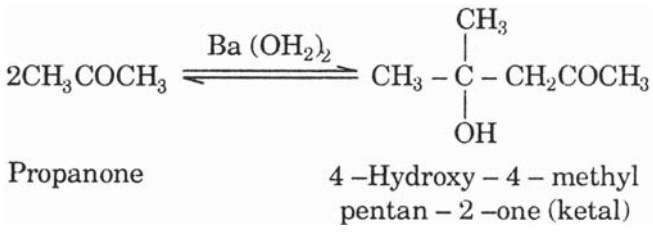
Describe the following reaction :
1. Aldol condensation
2. Cross aldol condensation
3. Cannizaro reaction
4. Tischenko reaction

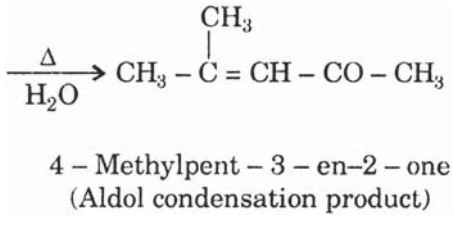
Ans :

1. **Aldol Condensation :** Aldehydes and ketones having at least one α-hydrogen undergo a reaction in the presence of dilute alkali as catalyst to form β-hydroxy aldehydes (aldol) or β -hydroxy ketones (Ketol) respectively. This is called Aldol reaction.



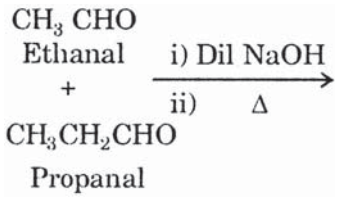


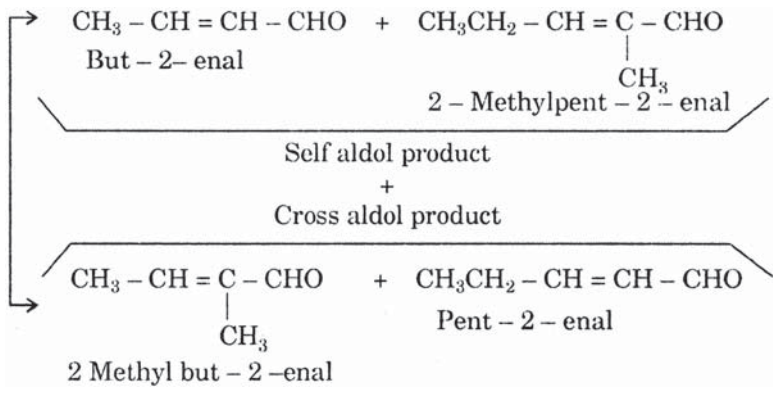




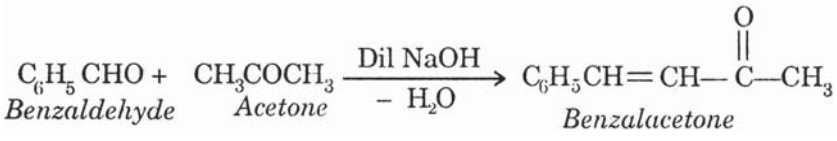
The name aldol is derived from the names of the two functional groups, aldehyde and alcohol, present in the products. The aldol and ketol readily lose water to give α,β-unsaturated carbonyl compounds which are aldol condensation products and the reaction is called Aldol condensation.

2. **Cross Aldol Condensation :** When aldol condensation is carried out between two different aldehydes or ketones. It is called Cross aldol condensation. If both of them contain α-hydrogen atoms, it gives a mixture of four products.

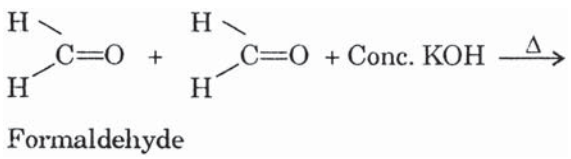


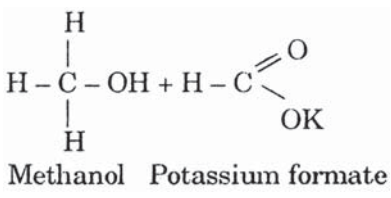


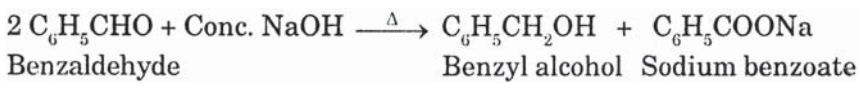
Cross aldol condensation between an aromatic aldehyde and an aliphatic aldehyde or a ketone is called claisen-schmidt condensation.



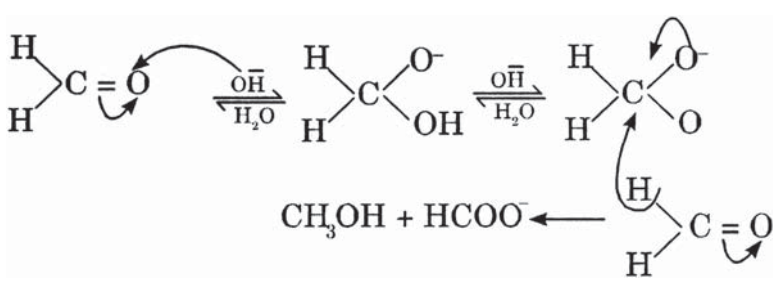
3. **Cannizaro reaction :** Aldehydes which do not have an α-hydrogen atom, undergo self oxidation and reduction (disproportionation) reaction on heating with concentrated alkali. In this reaction, one molecule of the aldehyde is reduced to alcohol while another is oxidised to carboxylic acid salt.







4. **Mechanism of Cannizaro's reaction :**



QUE 1.3

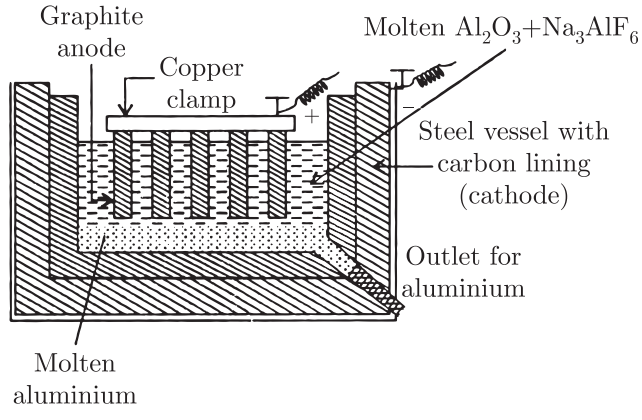
Explain in brief the Hall-Heroult process.

Ans :

Hall-Heroult Process : In this process a fused mixture of alumina (Al_2O_3), Cryolite (Na_3AlF_6) or Flourspar (CaF_2) is electrolysed using graphite as anode and steel vessel with lining of carbon acts as cathode. The overall reaction is:

$$2Al_2O_3 + 3C \longrightarrow 4Al + 3CO_2$$

During electrolysis of molten mass oxygen liberated at anode reacts with the carbon of anode producing CO and CO_2. This way for each kg of aluminum produced about 0.5 kg of carbon anode is burnt away.



Electrolytic cell for the extroction of aluminium

The electrolytic reactions are :

Cathode : $Al^{3+}(melt) + 3e^- \longrightarrow Al(l)$

Anode : $C(s) + O^{2-}(melt) \longrightarrow CO(g) + 2e^-$

$C(s) + 2O^{2-}(melt) \longrightarrow CO_2(g) + 4e^-$

OR QUE

How is nitric acid manufactured by Ostwald's process? How does it react with the following?

1. Copper
2. Zn
3. S_8
4. P_4

Ans :

Ostwald's Process

Ammonia, mixed with air in 1:7 or 1:8, when passed over a hot platinum gauze catalyst, is oxidised to NO mostly (about 95%). The reaction is,

$$4NH_3 + 5O_2 \xrightarrow[1155\,K]{\text{Pt. gauze}} 4NO + 6H_2O;\ \Delta H = -1275\,kJ$$

The liberated heat keeps the catalyst hot. The NO is cooled and is mixed with oxygen to give the dioxide, in large empty towers (oxidation chamber). The product is then passed in to warm water, under pressure in the presence of excess of air, to give HNO_3.

$$4NO_2 + O_2 + 2H_2O \longrightarrow 4HNO_3$$

The acid formed is about 61% concentrated.

1. Copper reacts with dil HNO_3 and conc. HNO_3 and liberates Nitric Oxide and Nitrogen dioxide respectively.

$$3Cu + 5HNO_3(dil) \longrightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$$

$$Cu + 4HNO_3(conc.) \longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$$

2. Zn reacts with dil. HNO_3 and Conc. HNO_3 and liberates Nitrous oxide and Nitrogen dioxide respectively.

$$4Zn + 10HNO_3(dil) \longrightarrow 4Zn(NO_3)_2 + 5H_2O + N_2O$$

$$Zn + 4HNO_3(conc.) \longrightarrow Zn(NO_3)_2 + 2H_2O + 2NO_2$$

3. S_8 reacts with conc. nitric acid to form Sulphuric acid, NO_2 gas.

$$S_8 + 48HNO_3 \longrightarrow 8H_2SO_4 + 48NO_2 + 16H_2O$$

4. P_4 reacts with conc. nitric acid to form phosphoric acid and NO_2 gas.

$$P_4 + 20HNO_3 \longrightarrow 4H_3PO_4 + 20NO_2 + 4H_2O$$

□□□□□□□