Set C

Group B

1. State and Explain ostwald dilution law. Also write the limitation of this law.

→ Ostwald's law of theory states that for a weak electrolyte the degree of dissociation is directly proportional to the square root of dilution.

let AB be a weak electrolyte, then it dissociates as

$$AB \rightleftharpoons A^+ + B^-$$

(molL^{-1} 0 0

initially,

At equilibrium, $C-C\alpha$ $C\alpha$ $C\alpha$

$$\left[\because \alpha = \frac{\text{Total dissociated } (n)}{\text{Total dissolved } (C)}\right]$$

$$n = C\alpha$$

Applying law of mass action,

$$K = \frac{[A^+][B^-]}{[AB]}$$

$$K = \frac{C\alpha \cdot C\alpha}{C - C\alpha}$$

$$K = \frac{C^2\alpha^2}{C(1-\alpha)}$$

$$K = \frac{C\alpha^2}{1-\alpha}$$

For weak

$1-\alpha \approx 1$

$K = C\alpha^2$

$\alpha = \sqrt{\frac{K}{C}} = \sqrt{K \times \frac{1}{C}} \left(\because \frac{1}{C} = V \right)$

$\alpha = \sqrt{K \times V}$

The above equation shows that the degree of dissociation of weak electrolyte α is directly proportional to square root of dilution.

Limitation

1. This law is not applicable to the strong electrolytes. because the value of α for strong electrolyte is 1.

ie. $K = \frac{C\alpha^2}{1-\alpha}$

$K = \frac{C\alpha^2}{1-1} = \frac{C\alpha^2}{0} = \infty$

which is indeterminate

on the other hand for strong electrolyte the ionization is not reversible process and therefore the law of mass action is not applicable.

2. How diethyl ether is prepared by using williamson's synthesis what happens when diethyl ether is exposed to atmospheric air in pre

nce of sunlight? Why it is dangerous to boil old sample of ether?

2) Sodium ~~alkoxide~~ alkoxide on reacting with chloroethane gives corresponding ether.

$$CH_3-CH_2-Cl + CH_3-CH_2-O-Na \xrightarrow{\Delta} CH_3-CH_2-O-CH_2-CH_3 + NaCl$$

chloroethane — diethyl ether

Ether undergo slow oxidation in presence of air and sunlight and forms peroxide of ether

$$2\,CH_3-CH_2-O-CH_2-CH_3 + O_2 \xrightarrow{light} 2[(CH_3CH_2-O-\overset{O}{\uparrow}-CH_2-CH_3]$$

peroxide of ether

It is dangerous to boil old sample of ether because the peroxide formed have high boiling point and explodes on boiling.

1) Activation energy is defined as the minimum amount of extra energy required by a reacting molecule to get converted into product.

Molecularity	Order
Molecularity is the no. of ions or molecules that take part in the rate-determining step	No. of molecule of the reactant whose concentration changes during the chemical change
It is always a whole no.	It can either be a whole no. or a fraction.
The molecularity of the reaction is determined by looking at the reaction mechanism.	The order of the reaction is determined by the experimental methods.
It is theoretical concept.	It is experimental concept.

Rate law	Rate constant
It depend upon the concentration of the reactant.	It is independent of the concentration of the reactant
It is expressed in terms of consumption of reactants or formation of product per unit time.	It is proportional; it is constant in differential form in rate
It generally decreases with the progress of the reaction	It doesn't depend on the progress of the reaction
Unit is $mol\,L^{-1}\,(m^{-1})$	It changes according to the order of the reaction

OR

rate constant

Solution:

Rate: $k [A_2]^m [B_2]^n$

$1.6 \times 10^{-4} = k[0.5]^m [0.5]^n$ — (i)

$3.2 \times 10^{-4} = k[0.5]^m [1.0]^n$ — (ii)

$3.2 \times 10^{-4} = k[1.0]^m [1.0]^n$ — (iii)

Dividing equation (i) by (ii)

$$\frac{3.2 \times 10^{-4}}{1.6 \times 10^{-4}} = \frac{k[0.5]^m [1.0]^n}{k[0.5]^m [0.5]^n}$$

$$2 = 2^n$$

$$n = 1$$

Dividing equation (iii) by (ii)

$$\frac{3.2 \times 10^{-4}}{3.2 \times 10^{-4}} = \frac{k[1.0]^m [1.0]^n}{k[0.5]^m [1.0]^n}$$

$$1 = 2^m$$

$$m = 0$$

The order of reaction with respect to A_2 is $m = 0$

The order of reaction with respect to B_2 is $n = 1$

order of reaction $= m + n$

$= 1 + 0 = 1$

From equation using the value of m and n we get

$1.6 \times 10^{-4} = k[0.5]^1 [0.5]^0$

$1.6 \times 10^{-4} = 0.5k$

$k = 3.2 \times 10^{-4}$ unit

4. Explain the following giving reasons.

a. mercury is a transition element but lithium is not.

b. Zn^{++} salt are white but Cu^{++} salt are blue.

:) Because the electronic configuration of Zn^{++} and Cu^{++} can be given as follow:

$Zn^{++} = [Ar]\ 3d^{10}$

$Cu^{++} = [Ar]\ 3d^{9}$

Here Cu^{++} has one unpaired electron while Zn^{++} have all paired electrons. In d-block elements, the element which has an unpaired electron shows colour. Thus Cu^{++} show colour.

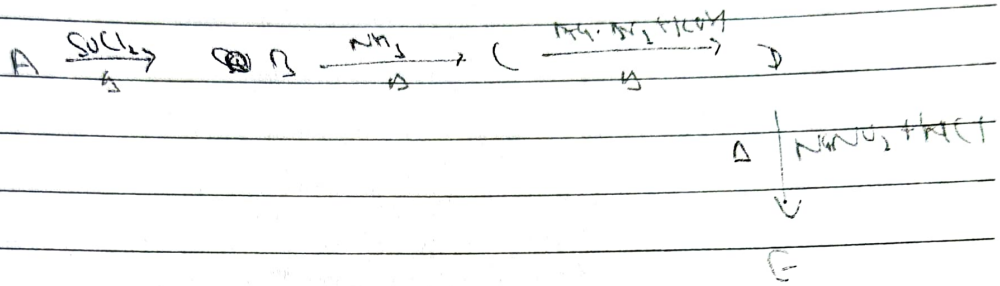
=) The cations of d-block elements have strong tendency to form complexes with certain molecules (eg CO, NO, NH_3 etc) or ion (eg F^-, Cl^-, CN^-) called ligands Their tendency to form complexes is due to two reasons
small size and high positive charge density of ions of transition metals.
presence of vacant $(n-1)d$ orbitals which are of appropriate energy to accept one pair and unshared pair of electrons from the ligands for bonding with them eg of some complex compounds are:
$[Cu(NH_3)_4]^{2+}$, $[Ag(NH_3)_2]^+$, $[Fe(CN)_6]^{4-}$ etc

d. Cu^{++} is more stable than Cu^+.

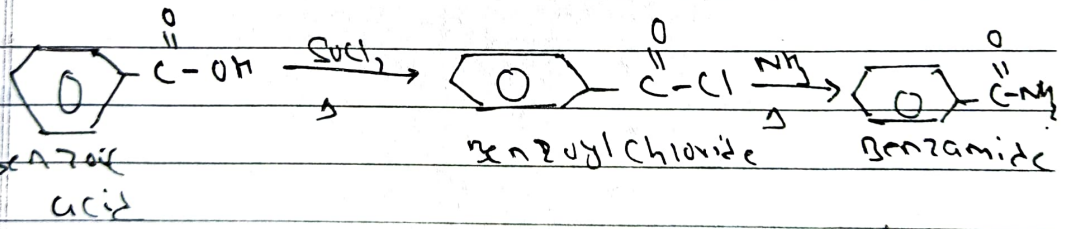
=) Cu^{++} ion is more stable than a Cu^+ ion due to the fact that the Cu^{++} ion has a high negative value of hydration enthalpy. means that more energy is released when Cu^{2+} is dissolved in water than in the case of Cu^+. Hence it's more stable.

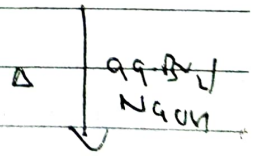
:) Iron is used in Haber cycle as a cheap catalyst. It allows in acceptable time to reach a reasonable yield. It states three conditions of reaction regulated in industrial reaction.

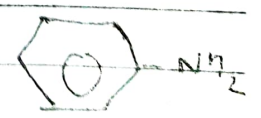
5. Consider a sequence reaction



The compound E has positive iodoform test. Identify A, B, C, D and E with their IUPAC name and write suitable reaction involved.







Aniline

A → Benzoic acid
B → Benzoyl Chloride
C → Benzamide
D → Aniline

6. Grignard's reagent is an important organometallic compound which is widely used in much organic synthesis?

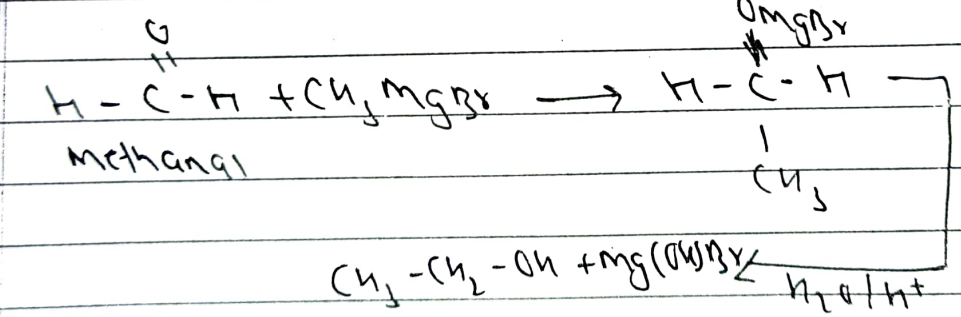
a. How can you prepare Grignard reagent?

b. How can you prepare (i) ethanol
(ii) propan-1-ol
(iii) 2-methyl propan 2-ol
(iv) propan-2-ol
by using suitable Grignard's reagent?

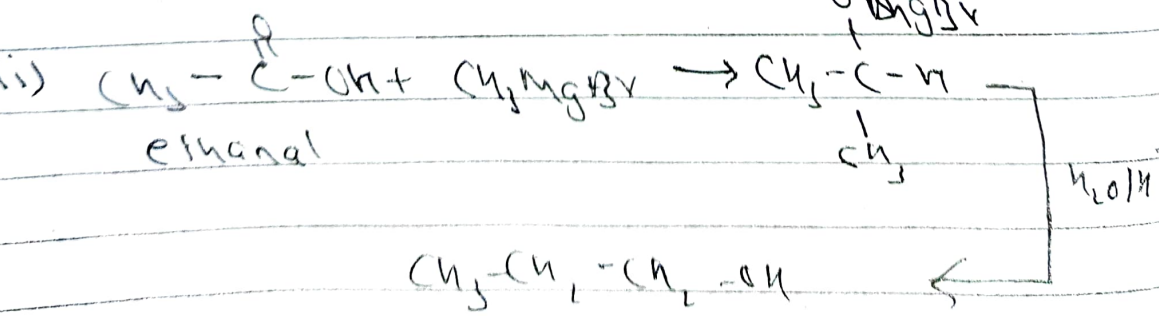
a. Grignard reagent can be prepared by reacting haloalkane with magnesium metal in presence of dry ether

$$R-X + Mg \xrightarrow[\Delta]{\text{dryether}} RMgX$$

b(i)



ii)



iii) $CH_3-\overset{O}{\overset{\|}{C}}-OH + CH_3MgBr \longrightarrow CH_3-\underset{CH_3}{\overset{OMgBr}{\overset{|}{C}}}-H \xrightarrow{H_2O/H^+} CH_3-\underset{CH_3}{\overset{OH}{\overset{|}{C}}}-H$

Ethanal

Propan-2-ol

iv. $CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + CH_3MgBr \longrightarrow CH_3-\underset{CH_3}{\overset{OMgBr}{\overset{|}{C}}}-CH_3$

Acetone

$\xrightarrow{H_2O/H^+}$

$CH_3-\underset{CH_3}{\overset{OH}{\overset{|}{C}}}-CH_3 + Mg(OH)Br$

2-methyl propan-2-ol

7. How is steel manufacture by open hearth process? What is used to oxidize the impurities in basic oxygen process? Write the composition of stainless steel.

:) 70-80% cast iron, 20-30% SCRAP iron and little haematite is used to manufacture steel by open hearth process. The charge is heated by passing producer gas ($CO + N_2$) in 1:2 ratio. It works on the following principle:

Regenerative type of heating system is used.

In this process, oxidation of impurities

haematite.

3. percentage of carbon is brought down by adding low grade scrap iron / wrought iron.

Depending upon the nature of impurities the open hearth process maybe acidic or basic process

Acidic process

If impurities present in iron ore has ic in nature or phosphorus content is low, acidic process is used. In acidic process, the hearth of the furnace is lined with acidic material such as SiO_2. The impurities are oxidized by hem. atite.

$2Mn + Fe_2O_3 \longrightarrow 3MnO + 2Fe$

$3Si + 2Fe_2O_3 \longrightarrow 3SiO_2 + 4Fe$

$MnO + SiO_2 \longrightarrow MnSiO_3$ (Slag)

A small quantity of charge is drawn out time to analyze the carbon content in the mixture. After adjusting the carbon content required. Calculated quantity of spiegeleisen (Mn + Fe + C) is added to obtain desired quantity of steel.

2. Basic process

If impurities present in cast iron are acidic in nature and consists more quantity of phosphorous then basic process is adopted. In this process the hearth of the furnace is lined with basic materials such as dolomite ($CaCO_3 \cdot MgCO_3$). The impurities are oxidized by haematite oves.

$$6P + 5Fe_2O_3 \xrightarrow{\Delta} 10Fe + 3P_2O_5 \uparrow$$
$$3P_4 + 10Fe_2O_3 \xrightarrow{\Delta} 20Fe + 6P_2O_5 \uparrow$$
$$CaCO_3 \xrightarrow{\Delta} CaO + CO_2 \uparrow$$
$$3CaO + P_2O_5 \xrightarrow{\Delta} Ca_3(PO_4)_2 \text{ (thomas slang)}$$

$$3S + 2Fe_2O_3 \xrightarrow{\Delta} 4Fe + 3SO_2 \uparrow$$
$$3C + Fe_2O_3 \xrightarrow{\Delta} 2Fe + 3CO_2 \uparrow$$

The composition of stainless steel is
Fe - 74-80
Cr - 10-18
Ni - 1-8

(a) $CH_3-CH=O + H_2N-NH-C_6H_3(NO_2)_2 \xrightarrow{H^+}$ $CH_3-CH=N-NH-C_6H_3(NO_2)_2$

2,4-DNP

acetaldehyde 2,4-dinitro phenyl hydrazone

(2,4-DNP derivative of acetaldehyde)

(b) $RCHO + 2[Ag(NH_3)_2]^+OH^- \xrightarrow{-H_2O}$

aldehyde

$RCOONH_4 + Ag\downarrow + NH_3$

(c) $RCHO + CuO \longrightarrow Cu_2O\downarrow + RCOOH$

aldehyde

d. $C_6H_5NH_2 \xrightarrow[273K]{HCl/HNO_2} C_6H_5N_2Cl + NaCl + H_2O$

aniline

BDC

e. $C_6H_5N=N-Cl + H-C_6H_4-OH \xrightarrow{OH^-}$

B.D.C

phenol

$\rightarrow C_6H_5-N=N-C_6H_4-OH$

p-hydroxyazobenzene

OR.

An organic compound 'P' reduce Tollen's reagent and on oxidation with potassium dichromate forms a compound 'Q'. Q reacts with aqueous Na_2CO_3 to give carbon dioxide gas. Q on reaction with ethanol in presence of sulphuric acid forms an ester having molecular formula $C_4H_8O_2$ 'R'. Identify P, Q and R and write their IUPAC name.

The compound 'P' must be aldehyde because it reduce Tollen's reagent

$R'CHO \xrightarrow[[O]]{KMnO_4/H^+} R'COOH$

Aldehyde (P) → Carbonylic Acid (Q)

$CH_3-CH_2-OH \xrightarrow[conc.\ H_2SO_4]{}$

$R'-\overset{O}{\overset{\|}{C}}-O-CH_2-CH_3$

ester (R)

But from the question the formula of R is $C_4H_8O_2$

Hence, R' must be CH_3. The reactions are as follows:

$CH_3-\overset{O}{\overset{\|}{C}}-H \xrightarrow[[O]]{KMnO_4/H^+} CH_3-\overset{O}{\overset{\|}{C}}-OH \xrightarrow{CH_3-CH_2-OH,\ conc.\ H_2SO_4}$

Ethanal (P) → Ethanoic acid (Q)

$CH_3-\overset{O}{\overset{\|}{C}}-O-CH_2-CH_3$

Ethyl ethanoate (R)

$2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + CO_2 + H_2O$

Ethanoic acid — Sodium ethanoate

(Q)

Therefore, P: Ethanal, Q: Ethanoic acid

R: Ethyl ethanoate.

Group 'C'

9. Applied Chemistry is the scientific field for understanding basic chemical properties of materials and for producing new materials with well-controlled functions.

a. Draw the flow sheet diagram for the manufacture of portland cement.

b. Show the advantages of pozzolana portland cement over ordinary portland cement.

Quarrying Raw material

↓

Raw material processing (primary an secondary crushing)

↓

Raw material preparation (proportioning and grinding)

water ↓ (left branch) | ↓ (right branch)

Slurry mixing and blending ↓ → Rotary klin

Dry mixing and blending ↓ → Preheater/precalciner ←→ Rotary klin

Rotary klin

↓

Clinker cooler

↓

Clinker storage

↓

Gypsum flyash → Clinker grinding

↓

Packing and dispatch

5. The strength of PPC is better than OPC in long term

→ PPC is durable in aggressive weather but OPC is not.

→ It causes less environmental pollution than opc production

→ It is cheaper than opc.

→ It has has higher fineness than opc. Therefore it has lower prem. easility resulting in higher durability than opc.

C.	Kraft pulping	Sulphite pulping
1.	Kraft pulping is a technique used to convert wood into wood pulp using a mixture of water, Sodium hydroxide and sodium sulfide	1. Sulfite pulping is a technique use to produce wood pulp using Sulfite or bisulfite salts of sodium, calcium, potassium, magnesium, and ammonium.
2.	~~It produce weak cellulose fibers produce weak~~ cellulose fiber	produce strong cellulose fibers.
3.	Efficiency is comparatively low.	Efficiency is comparatively high.
4.	Doesn't harm to the environment	4. less environmentally cost

d. The ~~step~~ paper making process include

(a) forming and web:
The fibrous pulp which is about 99.5 % watery slurry is then run at the speed of 5m/min in a cloth belt. Then it is suspended under gravity to lower the water

(b) pressing the wet web:
Even after suspending the slurry under gravity it still contain 80% water. Therefore it is passed through belt roll (press-section) to lower the water content to 60-65%.

(c) Drying the sheet:
Finally the sheet is passing through steam heated chamber for drying and the paper are rolled cut ~~(int~~ into size and packed for distribution.

a. Define titration

b. Why do you need to repeat titration until concurrent consecutive titres are obtained?

c. When indicator show the change in colour acid is added to base slowly until end point is reached. Define end point and distinguish it with equivalence point.

d. In a titration between H_2SO_4 and NaOH which indicator is used? Give reason.

e. What is primary standard substance?

a.

⇒ Titration is a laboratory process of measuring the volume of a unknown solution which exactly reacts with the known volume of a standard solution

b. A titration is ~~repeated~~ repeated until concurrent consecutive titres are obtained in order to provide a statistically valid answer. This form of volumetric analysis to uncover the concentration of a substance, and the reading should all be within a very small number of units of one another.

6. The point in the titration at which the completion of the reaction is indicated by the change in colour of the indicator is called end point.

Equivalence point	End point
The point in the titration process where the chemical reaction in the titration mixture ends is called equivalence point.	The point in the titration process which is indicated by colour change of the indicator is called end point.
It is not always indicated by colour change of the reaction mixture	It is always indicated by the colour change of the reaction mixture
It comes either almost with endpoint or before the end point.	It comes either almost with the equivalence point or after the equivalence point.

d. The neutralization point can be determined by the use of indicator. The indicator used when sodium hydroxide is titrated against Sulphuric acid is phenolphthalein

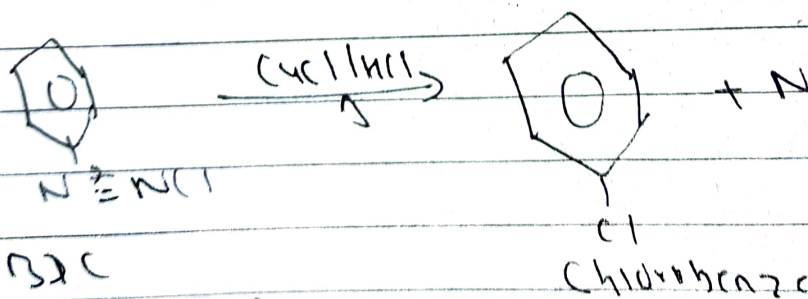
e. Those substances which can be directly weighed without error to make the standard solution are called primary standard Sub. stance. eg:- Na_2CO_3, K, Cr_2O_7 etc

11. Chlorobenzene is an imp. starting material for the preparation of insecticides like DDT which used in agricultural field.

a. How would you prepare Chlorobenzene by Sandmeyer's and Gattermann reaction)

Sandmeyer's

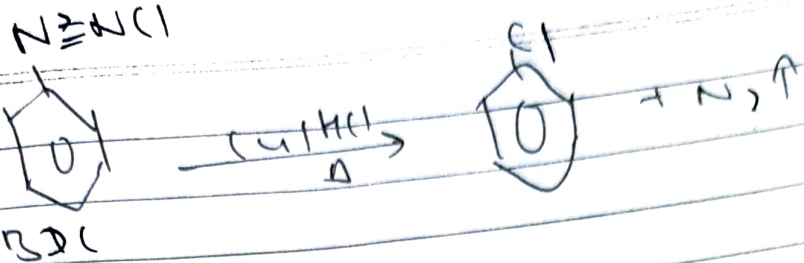
BDC on reaction with CuCl and HCl gives chlorobenzene



BDC Chlorobenzene

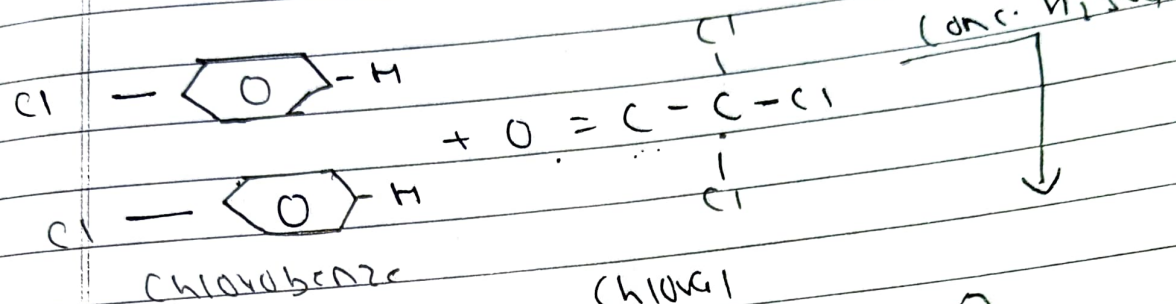
Gattermann

BDC on heating with Copper and and HCl gives chlorobenzene.



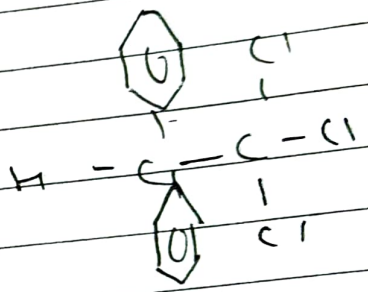
benzene diazonium chloride

b. Write a chemical reaction



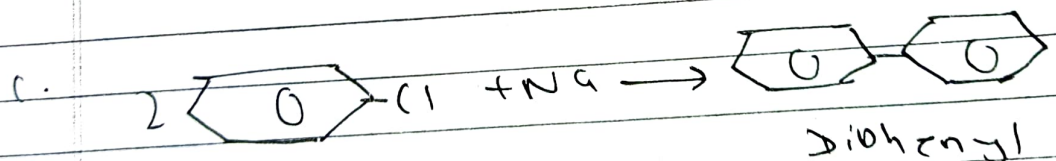
Chlorobenzene

Chloral



DDT

+ H₂O

c. 

Diphenyl

+ 2NaCl