$$HNO_3 + HI \longrightarrow NO_2 + I_2 + H_2O$$

$$H\overset{+5}{N}O_3 + HI + \overset{-1}{H}\overset{0}{I} \longrightarrow \overset{+4}{N}O_2 + \overset{0}{I_2} + H_2O$$

1 x 3

3

$$HNO_3 + 2HI + 3HI \longrightarrow NO_2 + 3I_2 + H_2O$$

$$HNO_3 + 5HI \longrightarrow$$

$$HNO_3 + 2HI \longrightarrow NO_2 + I_2 + H_2O$$

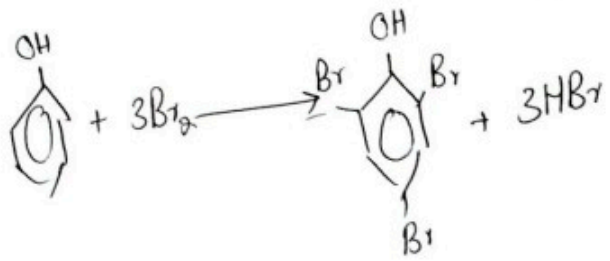
$$HNO_3 + 6HI \longrightarrow$$

1 x 3

$$\overset{+5}{H}\overset{+5}{N}O_3 + HI + \overset{+1}{H}\overset{-1}{I} \longrightarrow \overset{+2}{N}O + \overset{0}{I_2} + H_2O$$

3

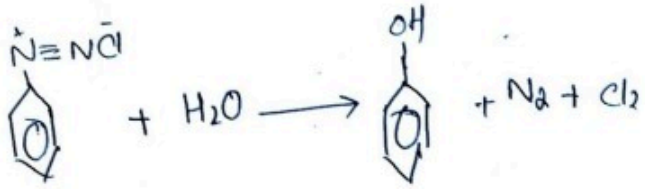
$$2HNO_3 + [illegible] + 6HI \longrightarrow 2NO + 3I_2 + 4H_2O$$


OH
+ 3Br2
OH
Br
Br
Br
+ 3HBr

(Be)

(a)

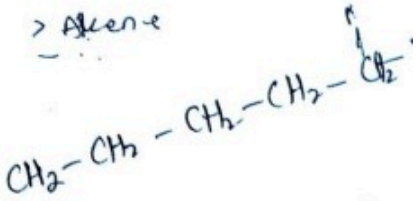
$CH_3-CH_2-Cl + KCN$

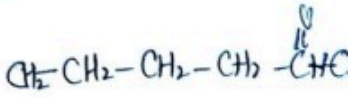


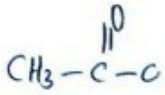
12 + 3 + 12 + 2 + 12 + 2

Alkane > Ben > Alkene

cp







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

$x = 2 = -2$

x.

$x + 4(0) + (-1)(-1)(-2)$

$x = (-1)(-1)$.

$x + 0 + -1 - 1 - 2$

(Section B)

Q. No. 2 Part (i) **Cell Reaction:**

$Fe^{+3} + e \longrightarrow Fe^{+2}$ $(E^\circ = +0.77V) \longrightarrow i$

$Zn^{+2} + 2e \longrightarrow Zn$ $(E^\circ = -0.76) \longrightarrow ii$

Identification of oxidation and reduction reaction: Hence the value of E° for 1st reaction i-e $(Fe^{+3} + e \longrightarrow Fe^{+2})$ is higher than that of 2nd reaction. So, Fe^{+3} at cathode is reduced to Fe^{+2} while Zn is oxidized to Zn^{+2} at anode.

At anode: $Zn \longrightarrow Zn^{+2} + 2e$ (Oxidation reaction)

At cathode: $Fe^{+3} + e \longrightarrow Fe^{+2}$ (Reduction reaction)

↳ The electron flow from anode to cathode.

↳ E° of cell = E° cathode − E° anode

E° of cell = $0.77V - (-0.76V) = 1.53V$ this reaction is feasible and spontaneous

---

Q. No. 2 Part (ii) **pH maintainence in blood**

The human blood is slightly alkaline having pH of 7.35 – 7.45. This pH of human blood is maintained by carbonic acid which is formed from CO_2 and H_2O. The carbonic acid breaks down and acts as a buffer solution for blood.

$$CO_2 + H_2O \xrightarrow{\text{carbonic anhydrase}} H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$$

When acid enters the blood:

$$H^+ + HCO_3 \longrightarrow H_2CO_3$$

When basicity increase in blood

$$OH^- + H_2CO_3 \longrightarrow HCO_3^- + H_2O$$

Thus pH is maintained in blood.

(Section B)

Q. No. 2 Part (III) **Kb values of base:**

A: 1.8×10^{-5}

B: 1.0×10^{-2}

The Kb is the base ionization constant. Higher the value of Kb stronger will be the base and vice versa.

The Kb value of base B is higher than that of base A.

So, B is stronger base than A.

B will more ionize into its ions in water than A.

.....

Q. No. 2 Part (iv) **IUPAC name of coordination compounds**

a) $[Pt(NH_3)_4BrCl]SO_4$

Let the oxidation number of $Pt = x$

$Pt = x$, $NH_3 = 0$, $Br = -1$, $Cl = -1$, $SO_4 = -2$

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

$x + 0 - 4 = 0$

$x = 4$ Tetraammine bromochloroplatinum(IV) sulph

b) $K_4[Fe(CN)_6]$ let oxidation numbes of $Fe = x$

$K = +1$, $CN = -1$

$4(+1) + x + 6(-1) = 0$

$x + 4 - 6 = 0$, $x - 2 = 0$, $x = 2$

Potassium hexacyanoferrate (II)

(Section B)

Q. No. 2 Part (v) **Uses of group-II elements**

Industry: Limestone is used commercially for many industrial process. Limestone contains calcium carbonate which is converted to lime to make cements. It is also used to make marbles.

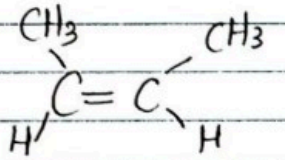
$$CaCO_3 \xrightarrow{\Delta} CaO + CO_2 \rightarrow \text{Lime}$$

Agriculture: Slaked lime (calcium hydroxide) is used to increase pH of soil for enhancing plants growth.

$$2Ca(OH)_2 + 2H^+ \longrightarrow 2CaO + 2H_2O + H_2$$

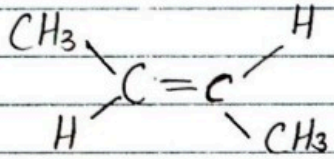
Medicines: Barium sulphates are used to treat diseases related to stomach and intestine because it is not absorbed in gut. Calcium carb is used as antacid. $CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO$

Q. No. 2 Part (vi) **Cis-Isomer of but-2-ene**



Cis-but-2-ene

Trans-Isomer of but-2-ene

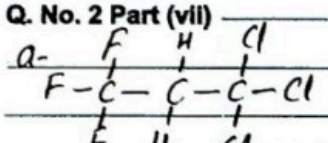


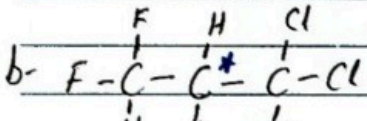
Trans-but-2-ene

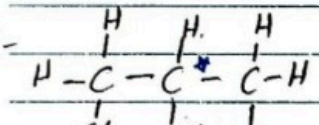
Stability: The trans-but-2-ene is more stable than cis-but-2-ene due to less repulsion between atoms and group

(Section B)

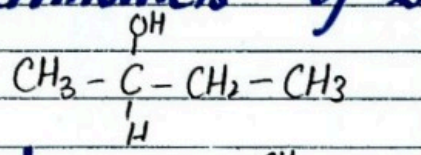
Q. No. 2 Part (vii)

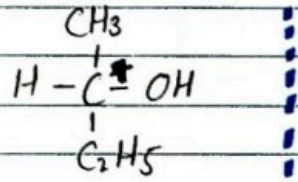
a-  This is achiral molecule.

b-  This is chiral molecule.

c-  This is a chiral molecule.

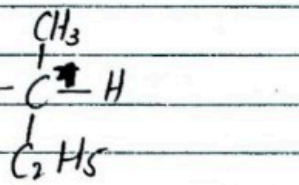
Q. No. 2 Part (viii) **Enantiomers of 2-butanol**





(+ve) 2-butanol
Dextrorotatory 2-butanol

mirror



(-ve) 2-butanol
Levorotatory 2-butanol

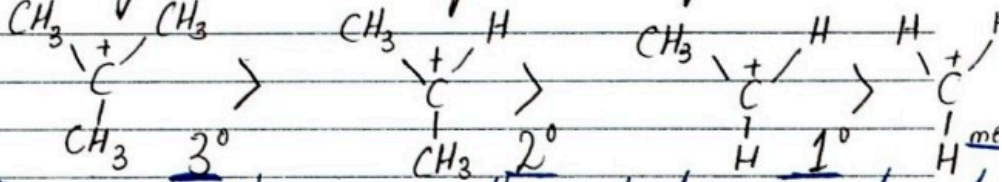
The highlighted carbon (carbon-2) is a chiral centre because it is attached with four different atom or group of atoms

(Section B)

Q. No. 2 Part (ix) **Stability of primary, secondary and tertiary carbocation:**

The stability order of primary, secondary and tertiary carbocation is as follows:

Tertiary > Secondary > Primary



This is because the tertiary carbocation contains three alkyl group which is electron donating in nature and stabilises the positive charge on carbon. Similarly secondary carbocation contains 2-electron donating group and primary has one for bulky gro

Q. No. 2 Part (x)

Amides do not readily accept hydrogen / proton like amines because amides are less basic than amine because in amides there is a highly electronegative atom attached with carbon bonded to nitrogen. So, electron is not easily available for hydrogen. while in amines the bulky group donates its electron density towards nitrogen so hydrogen can easily be accepted

(Section B)

Q. No. 2 Part (xi)

Monosaccharides: The simplest type of carbohydrate which cannot be hydrolyze is called monosaccharide.

2- They are of sweet taste.

3- They are highly soluble in water.

for example: Glucose.

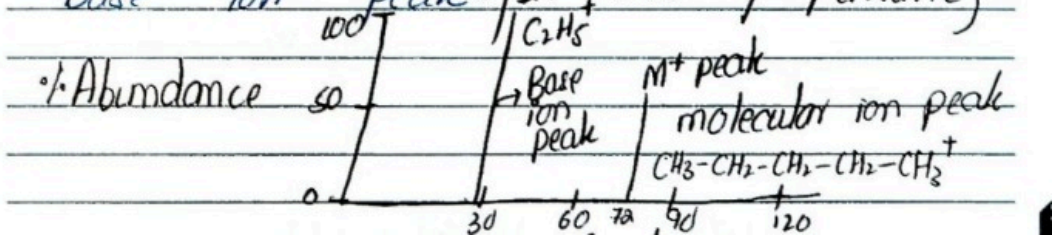
Disaccharide: Type of carbohydrate which upon hydrolysis produces 2-10 monosaccharides. They are of less sweet taste than monosaccharide are soluble in water. for example: sucrose

Polysaccharide: Type of carbohydrate which upon hydrolysis produces hundreds to thousands of monosaccharide. They are usually tasteless and insoluble in water. i-e cellulose

Q. No. 2 Part (xii)

Molecular Ion Peak: The peak obtained in mass spectrometry which has the same m/z value as the actual molecule has. It represent the mass of molecule.

Base Ion peak: The most intense peak which shows the most stable ion of molecule is called base ion peak. {In case of Pentane}



(Section B)

Q. No. 2 Part (xiii)

Mobile phase: Mobile phase is the component of chromatography that moves across the stationary phase. The mobile phase is a pure substance or mixture of pure substances.

Rf value = The ratio of the distance travelled by the solute to the distance travelled by the the solvent or mobile phase is called Rf value / retardation factor. $Rf = \frac{\text{Distance travelled by solute}}{\text{Distance travelled by solvent}}$

Q. No. 2 Part (xiv) **Properties of Alloys**

1- Alloying increase the conductivity of metals by several phenomenos.

2- Alloying increase hardness of metal.

3- Alloying increase ductility of metal.

for example: Iron.
Brass (Alloy of copper and zinc)
Bronze (Alloy of copper and tin).

(Section C)

Q. No. 3 (Page 1)

Balancing Redox Equations

Actual Equation:

$$P + HNO_3 + H_2O \longrightarrow H_3PO_4 + NO$$

Steps:

1- Finding oxidation states of all elements:

$$\overset{0}{P} + \overset{+1\ +5\ 3(-2)}{HNO_3} + \overset{2(+1)-2}{H_2O} \longrightarrow \overset{3(+1)+5\ 4(-2)}{H_3PO_4} + \overset{+2\ -2}{NO}$$

2- Identification of the element undergoing oxidation and reduction.

As the oxidation number of "P" has increased from 0 to +5 so it is oxidized while the oxidation state of "N" has decreased from +5 to +2 so it is reduced.

3 Draw a bridge between the oxidized and reduced elements and write the number of electrons lose or gain

(Section C)

Q. No. 3 (Page 2)

$$\overset{0}{P} + \overset{+5}{HNO_3} + H_2O \longrightarrow \overset{+5}{H_3PO_4} + \overset{+2}{NO}$$

+3es

-5es

④ Balance the number of electrons by multiplying with a suitable number to get a small common number. Use that number as coefficient of respective elements.

$$P + HNO_3 + H_2O \longrightarrow H_3PO_4 + NO$$

3 x 5

5es x 3

$$3P + 5HNO_3 + H_2O \longrightarrow 3H_3PO_4 + 5NO$$

⑤ Balance the rest part by inspection method.

$$3P + 5HNO_3 + 2H_2O \longrightarrow 3H_3PO_4 + 5NO$$

(Section C)

Q. No. 3 (Page 3)

Using the same method for this reaction:

$\overset{+1\ +5\ 3(-2)}{HNO_3} + \overset{+1\ -1}{HI} \longrightarrow \overset{+2\ -2}{NO} + \overset{0}{I_2} + H_2O$

Here we should write one more HI

↳ Identifying oxidized and reduced element. Here 'N' is reduced. Its oxidation number changes from +5 → +2. and I is oxidized (-1-0)

$\overset{+5}{HNO_3} + 2\overset{-1}{HI} \longrightarrow \overset{+2\ -2}{NO} + \overset{0}{I_2} + H_2O$

1e

3es

∴ I is converted from monoatomic to diatomic.

* Multiplying with suitable number:

$HNO_3 + 2HI \longrightarrow NO + I_2 + H_2O$

1es x3

3es x1

So, equation becomes

$HNO_3 + 6HI \longrightarrow NO + 3I_2 + H_2O$

Balancing the rest part by inspection method

$2HNO_3 + 6HI \longrightarrow 2NO + 3I_2 + 4H_2O$

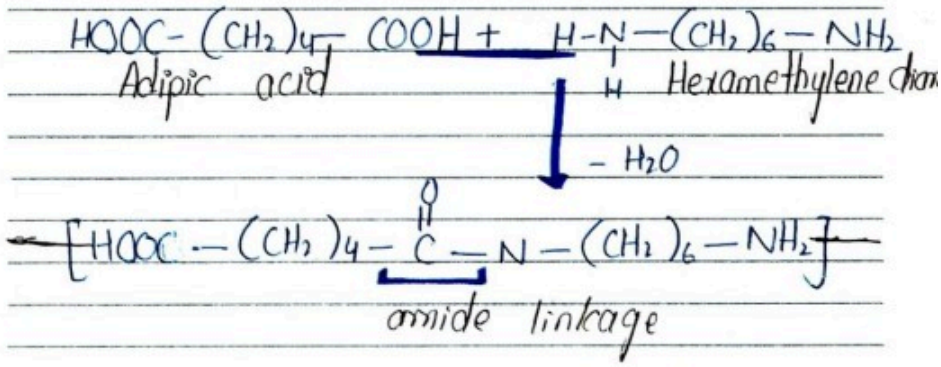
(Section C)

Q. No. 4 (Page 1)

Preparation of Nylon-6,6

Nylon-6,6 is formed by the reaction of adipic acid and hexamethylene diamine.

The reaction is as follow:



Nylon-6,6 is formed by condensation reaction.

Amide linkage is present between adipic acid and hexamethylene diamine.

The COOH group of adipic acid and NH_2 group of hexamethylene

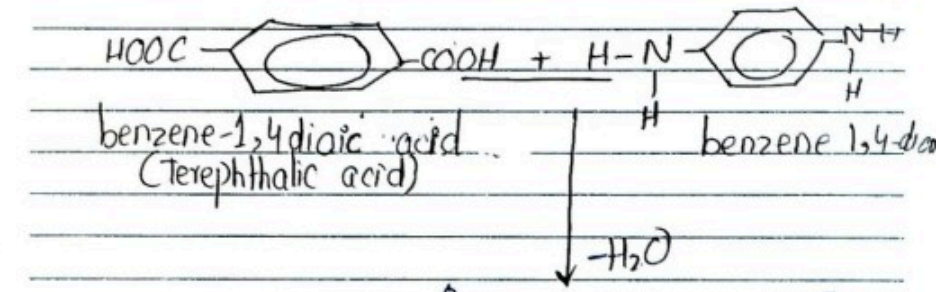
(Section C)

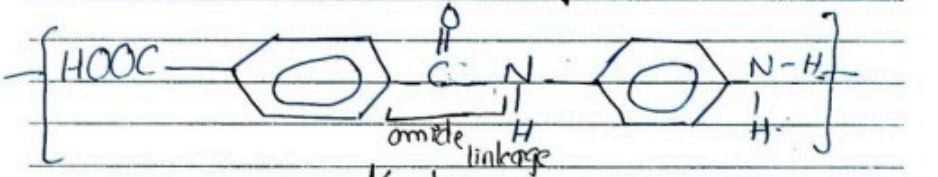
Q. No. 4 (Page 2)

diamine can further participate in reaction.

Preperation Of Kevlar

Kevlar is formed by reaction of benzene 1, 4-dioic acid (Terephthalic acid) and benzene 1-4 diamine. It is formed by condensation reaction. Amide linkage is present between monomers of Kevlar.





Kevlar

The COOH group of benzene-1, 4 dicarboxylic acid and NH_2 group of benzene 1, 4

(Section C)

Q. No. 4 (Page 3)

diamine can further perform reaction.

Both Nylon-6,6 and Kevlar is type of condensation polymer. The monomers of Nylon 6,6 and kevlar is different so they are Copolymer as well. The amide linkage ($-\overset{O}{\overset{\|}{C}}-N$) is present in them so they are polyamides.

(Section C)

Q. No. 5 (Page 1)

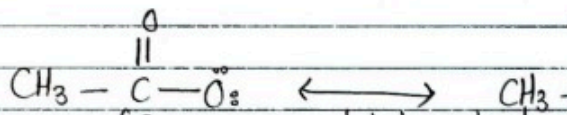
Acidic Strength:

(Ethanoic acid)

The acidic strength of ethanoic acid is greater than the acidic strength of phenol and ethanol.

This is because the ethoxide ion is more stable than that of phenol and ethanol.

The ethoxide ion is more stable because is has two stable resonance structure.



(Resonance stabilize structure of ethoxide ion)

These two resonance structure of ethoxide ion is stable So ethanoic acid is more acidic than phenol and ethanol.

The stability of ethoxide ion is because of resonance.

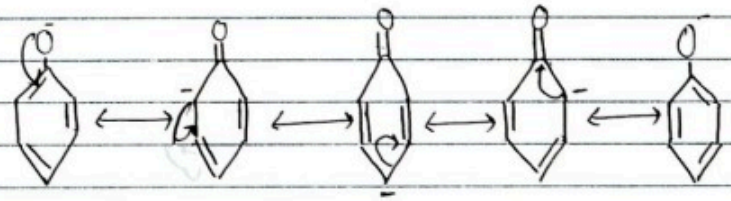
(Section C)

Q. No. 5 (Page 2)

(Phenol)

The phenol is less basic than ethanoic acid. However it is more acidic than ethanol due to the stability of phenoxide ion.

The phenoxide ion is more stable than the conjugate base of ethanol because phenoxide ion has five possible stable resonance structure, Due to resonance it is more stable.



(Resonance stabilized Structure of Phenoxide ion)

(Section C)

Q. No. 5 (Page 3)

(Ethanol)

$CH_3 - CH_2 - OH$

Ethanol is less acidic than ethanoic acid and phenol because its conjugate base is less stable than that of ethanoic acid and phenol

Due to less stability of conjugate base of ethanol it is less acidic.

$CH_3 - CH_2 - O^-$

Thus the acidic strength is as

Ethanoic acid > Phenol > Ethanol

(Section C)

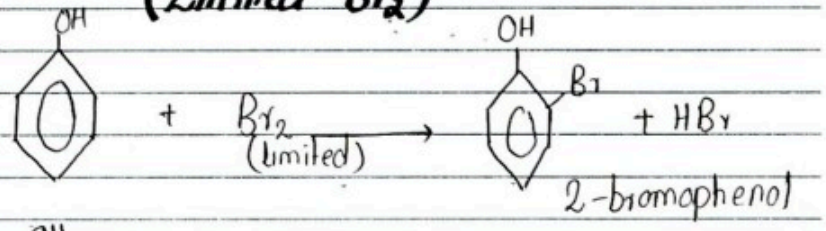
Q. No. 6 (Page 1)

Reaction of Phenol with Bromine water

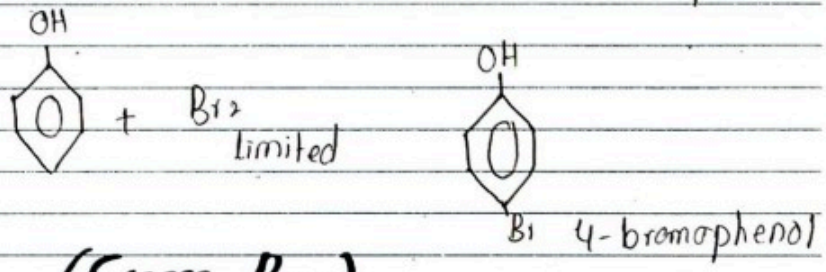
Condition: Room Temperature.

Phenol reacts with bromine water at room temperature. The OH group in phenol directs the incoming Bromine at ortho and para position. The reaction is as follow

(Limited Br_2)

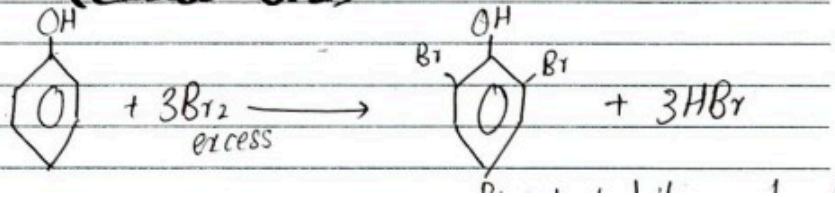


2-bromophenol



4-bromophenol

(Excess Br_2)



(Section C)

Q. No. 6 (Page 2)

This reaction decolorizes the reddish brown color of bromine water and form white ppt.

This reaction can be used to check the presence of phenol.

Comparison with bromination of Benzene:

In the bromination of benzene a catalyst $FeBr_3$ is used. The $FeBr_3$ is used as lewis acid. It accepts hydrogen from benzene.

The catalyst is not used in bromination of phenol while used in bromination of benzene because benzene is less reactive than phenol. The phenol contains "OH" group which is a ring activating

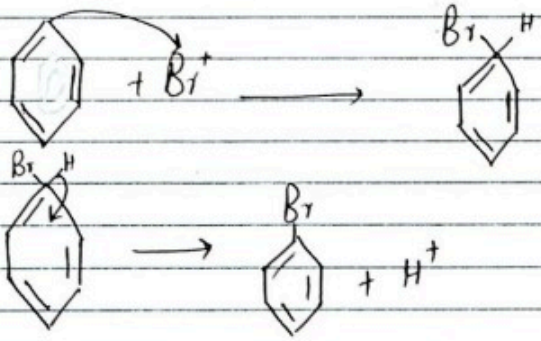
(Section C)

Q. No. 6 (Page 3)

group and thus increase the reactivity of ring.

Reaction of Bromine with Benzene.

$Br_2 \rightarrow Br^+ + FeBr_3 \longrightarrow Br^+ + FeBr_4^-$



$FeBr_4^- + H^+ \longrightarrow FeBr_3 + HBr$

* Benzene + Br_2 $\xrightarrow{\text{catalyst}}$ Bromobenzene
* Phenol + Br_2 $\xrightarrow{\text{catalyst not used}}$ bromophenol