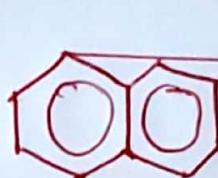


KIBUGO DENNIS

0750-732031

P525/2
CHEMISTRY
Paper 2
July / Aug. 2022
2 ½ hours



~~Kib~~

26th Sept 2022



UGANDA TEACHERS' EDUCATION CONSULT (UTEC)

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

Answer FIVE questions including three questions from Section A and any two questions from Section B.

Begin each question on a fresh page.

Mathematical tables and graph papers are provided.

Non-programmable scientific electronic calculators may be used.

Illustrate your answers with equations where applicable.

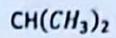
[C = 12, H = 1, 1 mol of a gas occupies 22.4 dm³ at s.t.p.]

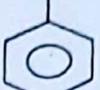
SECTION A:

Answer THREE questions from this section

1.
 - (a) Explain what is meant by the term **partition coefficient**. (02 marks)
 - (b) Describe an experiment used to determine partition coefficient of phenol between water and methyl benzene. (5 ½ marks)
 - (c) State **four** conditions under which the partition law is valid. (02 marks)
 - (d) 50 cm³ of 1.5M aqueous ammonia solution were shaken with 50 cm³ of trichloromethane and the mixture left to settle to attain equilibrium at 200K. At equilibrium, 20cm³ of trichloromethane layer required 23.0 cm³ of 0.05M hydro chloric acid for neutralization. Calculate the partition coefficient of ammonia between water and trichloromethane at 200K. (3 ½ marks)
 - (e) 1.5 g of an impure ore of zinc was dissolved in excess ammonia and the resultant solution shaken with trichloromethane and mixture left to settle to attain equilibrium. At equilibrium, 50 cm³ of the organic layer required 30cm³ of 0.062M hydrochloric acid for neutralization which 20 cm³ of the aqueous layer required 40cm³ of 0.5M hydrochloric acid for neutralization using methyl orange as indicator. The partition coefficient of ammonia between water and trichloromethane is 25.0 at 20°C and 1 mole of zinc complexes 4 moles of ammonia ($Zn(NH_3)_4^{2+}$). Calculate;
 - (i) Concentration of ammonia in trihloromethane in moldm⁻³. (½ marks)
 - (ii) Concentration of free ammonia in aqueous layer in moldm⁻³. (½ marks)
 - (iii) Concentration of complexed ammonia in aqueous layer in moldm⁻³. (04 marks)
 - (iv) Percentage purity of the zinc ore. (Zn = 65)
2. An organic compound Q contains 40% carbon, 6.67% hydrogen, the rest being oxygen.
 - (a) Determine the simplest formula of Q. (C=12, H = 1, O=16). (03 marks)
 - (b) A solution of 28.145g of Q in 250g of water had a freezing point of -349°C.
 - (i) Determine the molecular formula of Q if cryoscopic constant K_f of water is 1.86°C mol⁻¹ per kg⁻¹. (3 ½ marks)
 - (ii) Write structural formulæ and IUPAC names of all possible isomers of Q. (02 marks)
 - (c) When sodium hydrogen carbonate was added to Q there was no observable change.
 - (i) Name Q (½ mark)
 - (ii) Using equations, show how Q is synthesized from bromomethane.

- (d) (i) Write equation for the reaction between Q and water in presence of alkali catalyst and heat. (1 ½ mark)
(ii) Outline a mechanism for the reaction in (d) (i). (½ mark)
(c) Name the process in (d) and state one practical application of it. (02 marks)
(e) (01 mark)



- (f) (i) By means of equations only show how  can be formed from

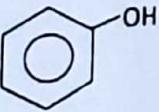


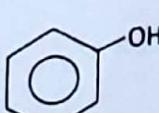
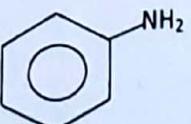
Ethyne. (04 marks)

- (ii) State one practical application of the reactions in (f) (i) and one advantage and disadvantage of the product. (02 marks)

3. (a) (i) Name the major ore from which copper is extracted. (½ mark)
(ii) Describe how copper is extracted from the ore you have named in (a) above. (06 marks)
(b) Describe the reaction of copper with acids. (Include equations for the reaction). (08 marks)
(c) State what is observed and in each case explain your observation when;
(i) Dilute sulphuric acid is added to copper (I) oxide. (2 ½ marks)
(ii) Ammonia solution is added to a solution of copper (II) sulphate drop wise until in excess. (03 marks)

4. (a) Name a reagent which is added to each of the following pairs of organic compounds, give the same or similar observations in each case. State what is observed and write equations for the reaction that takes place.
(i) $\text{CH}_3\text{CH}_2\text{C} \equiv \text{CH}$ and $\text{CH}_3\text{CH} = \text{CHCH}_3$ (04 marks)

- (ii)  and $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ (03 marks)

- (iii)  and  (05 marks)

- (b) For each of the pairs of organic compounds shown in (a)(i) and (a) (ii), name a reagent which is used to distinguish in each case state what is observed and write equations for the reaction that takes place. (08 marks)

SECTION B
Attempt TWO questions only

- ✓ (a) State two Faradays laws of electrolysis. (02 marks)
- (b) A current of 3A was passed for 20 minutes through a cell containing dilute sulphuric acid. Calculate the volume of hydrogen produced at the cathode collected at 25°C and 120KNm⁻² (F = 96500C). (05 marks)
- (c) The molarity of a sample of hydrochloric acid approximately 0.1M was determined accurately by measuring the conductivity of the solution as 1.0M sodium hydroxide solution was added to 50 cm³ of the acid and the results shown in the table below:

Conductivity ($\Omega^{-1}cm^1$)	4.1	3.3	2.4	1.7	1.5	1.8	2.2	2.5
Volume of 1M NaOH(cm ³)	1	2	3	4	5	6	7	8

- (i) Plot a graph of conductivity against volume of 1M sodium hydroxide added. (03 marks)
- (ii) Calculate the molarity of hydrochloric acid. (02 marks)
- (iii) Explain the shape of your graph. (4 ½ marks)
- (b) 2.72g of anhydrous zinc chloride was dissolved in water to make one litre of solution with distilled water. The conductivity of the solution was found to be $5.175 \times 10^{-3} \Omega^{-1} cm^{-1}$ at 25°C. Determine the molar ionic conductivity of chloride ions. (molar conductivity of zinc ions is $106\Omega^{-1}cm^2mol^{-1}$ Zn = 64.5, Cl = 35.5). (3 ½ marks)

The atomic numbers and boiling points of some of period 3 elements is shown below:

Element	P	S	Cl	Ar
Atomic number	15	16	17	18
Boiling point (°C)	500	550	400	0

- (a) (i) Plot a graph of boiling point against atomic number of the elements. (1 ½ marks)
- (ii) Explain the shape of your graph. (3 ½ marks)
- (b) Describe the reaction of phosphorus, sulphur and chlorine with sodium hydroxide. (5 ½ marks)

- (c) During extraction of aluminium from Bauxite; the ore is first roasted crushed into powder and digested with hot concentrated sodium hydroxide and filtered. State why:
- (i) The ore is roasted (½ mark)
- (ii) Digested with sodium hydroxide and filtered. (½ mark)
- (d) Write equation(s) for the reaction(s) in (c) (ii). (01 mark)
- (e) Briefly describe how pure aluminium can be obtained from the product of the reaction in (c) (ii). (5 ½ marks)
- (f) (i) Write equations for the reactions between aluminium and trimanganese tetra oxide. (½ mark)
- (ii) Name the process in (f) (i). (½ mark)
- (g) Write equation to show how pure anhydrous aluminium chloride can be prepared. (½ mark)
7. Explain the following observations;
- (a) When a solution of sulphur dioxide is added to potassium dichromate (VI) solution, orange solution turns to colourless. (02 marks)
- (b) Hydrogen fluoride is liquid at room temperature while hydrogen chloride is gas at room temperature. (03 marks)
- (c) An aqueous solution of chromium (III) chloride turns blue litmus paper to red. (2 ½ marks)
- (d) Tin (II) chloride is polar while boron trichloride is non – polar. (05 marks)
- (e) Methanoic acid is a stronger acid than ethanoic acid. (05 marks)
- (f) When a limited amount of chlorine is bubbled through sodium thiosulphate solution, a yellow solid is deposited. (2 ½ marks)
8. (a) In the laboratory preparation of 2, 3 – dibromobutane, 50g of but – 2 – ene gas was passed through 80g of liquid bromine covered by a layer of tetra chloromethane. (1 ½ marks)
- (i) State what was observed.

- (a) Write equation for the reaction that took place and suggest mechanism for the reaction. (3 ½ marks)
- (b) Assuming that all the bromine reacted with the alkene, calculate the mass of 2, 3 - dibromobutane that was formed. (4 ½ marks)
- (c) If the actual mass of 2, 3 - dibromo butane was 43.2g, calculate the percentage yield of 2,3 - dibromobutane from the reaction. ($C=2$, $H=1$, $Br=80$). (01 mark)
- (d) 1, 2 - dibromo ethane was heated with excess alcoholic aqueous potassium hydroxide solution.
- (e) Write equation for the reaction and suggest mechanism for the reaction. (05 marks)
- (f) By means of words only, show how the product in (b) can be converted to propanone. (4 ½ marks)

END

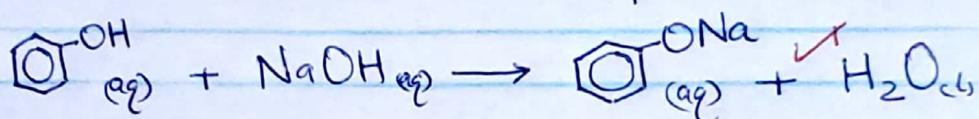
Question one.

(a) Is a constant ratio of the molar concentrations of a non-volatile solute in a mixture of two immiscible solvents in contact when equilibrium is attained at constant temperature provided the solute remains in same molecular state.

(b) A known mass of phenol is added to a known volume of methylbenzene in a flask.

A known volume of water is added to the mixture in the flask. The mixture is shaken and allowed to stand to attain an equilibrium at constant temperature.

Known volumes of aqueous and organic layers are pipetted in separate conical flasks and titrated with a standard solution of sodium hydroxide using phenolphthalein indicator.



Knowing the concentration of sodium hydroxide solution, the concentration of phenol in both layers (organic and aqueous) can be determined. (05%)

The partition coefficient of phenol between water and methylbenzene can be determined from the following expression

$$K_D = \frac{[\text{C}_6\text{H}_5\text{OH}]_{\text{aqueous layer}}}{[\text{C}_6\text{H}_5\text{OH}]_{\text{organic layer}}}$$

(c) Solvents in contact should be immiscible.

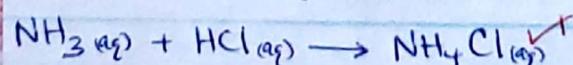
Temperature should be kept constant. (02)

Solute should neither dissociate nor associate in both solvents.

Solute should be soluble in both solvents.

(d) $[\text{NH}_3]_{\text{organic layer}}$.

$$\text{Moles of HCl} = \frac{(23 \times 0.05)}{1000} = 1.15 \times 10^{-3} \text{ mol}$$



Since 1 mole of HCl reacts with 1 mole of NH_3

$$1.15 \times 10^{-3} \text{ moles of HCl reacts with } \frac{1}{1} \text{ mole of NH}_3$$

$$= 1.15 \times 10^{-3} \text{ moles of NH}_3$$

$$[\text{NH}_3]_{\text{aqueous}} = 1.5 - 0.0575 \\ = 1.4425$$

$$K_D = \frac{[\text{NH}_3]_{\text{aqueous}}}{[\text{NH}_3]_{\text{organic}}} \\ = \frac{1.4425}{0.0575}$$

200 cm³ of solution contain 1.15×10^{-3} moles of NH_3

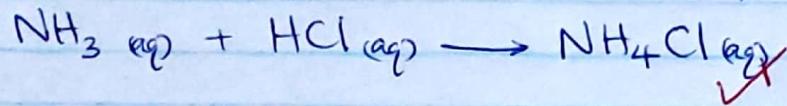
$$1000 \text{ cm}^3 \text{ of solution contain } \frac{1000}{20} \times 1.15 \times 10^{-3} \text{ moles of NH}_3$$

$$[\text{NH}_3]_{\text{organic layer}} = 0.0575 \text{ M}$$

$$K_D = \underline{\underline{25.0869}}$$

$$(e) (i) \text{ Moles of HCl} = \frac{(30 \times 0.062)}{1000} \text{ moles}$$

$$= 1.86 \times 10^{-3} \text{ moles of HCl.}$$



(Q2)

Since 1 mole of HCl reacts with 1 mole of NH_3

$$1.86 \times 10^{-3} \text{ moles of HCl react with } \left(\frac{1 \times 1.86 \times 10^{-3}}{1} \right) \text{ moles of } \text{NH}_3$$

$$= 0.186 \times 10^{-3} \text{ moles of } \text{NH}_3$$

50 cm³ of solution contain 1.86×10^{-3} moles of NH_3

$$1000 \text{ cm}^3 \text{ of solution contain } \left(\frac{1000 \times 1.86 \times 10^{-3}}{50} \right) \text{ moles of } \text{NH}_3$$

$$= 0.0372 \text{ M}$$

$$(ii) K_D = \frac{[\text{NH}_3]_{\text{free}}}{[\text{NH}_3]_{\text{organic}}}$$

$$25 = \frac{[\text{NH}_3]_{\text{free}}}{0.0372}$$

(Ans)

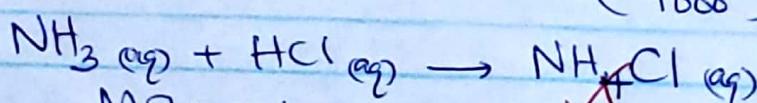
$$[\text{NH}_3]_{\text{free}} = 0.93 \text{ M.}$$

$$(iii) [\text{NH}_3]_{\text{complex}} = [\text{NH}_3]_{\text{total aqueous}} - [\text{NH}_3]_{\text{free}}$$

But Total/original $[\text{NH}_3]_{\text{aqueous layer}}$

1000 cm^3 of solution contain 0.5 moles of HCl

$$40 \text{ cm}^3 \text{ of solution Contain } \left(\frac{40 \times 0.5}{1000} \right) = 0.02 \text{ moles of HCl}$$



(Q2)

Mole ratio 1:1 \therefore Moles of NH_3 that reacted = 0.02 mol.

20 cm³ of solution contain 0.02 moles of NH_3

$$1000 \text{ cm}^3 \text{ of solution Contain } \left(\frac{0.02 \times 1000}{20} \right) \text{ moles of } \text{NH}_3$$

$$[\text{NH}_3]_{\text{total aqueous}} = 1 \text{ M}$$

$$\therefore [\text{NH}_3]_{\text{complex}} = [\text{NH}_3]_{\text{total aqueous}} - [\text{NH}_3]_{\text{free}}$$

$$= (1 - 0.93) = 0.07 \text{ M}$$

$$[\text{NH}_3]_{\text{complex}} = 0.07 \text{ M.}$$

$$(IV) \quad n = \frac{[NH_3]_{\text{complex}}}{[Zn^{2+}]}$$

$$4 = \frac{0.07}{[Zn^{2+}]}$$

$$[Zn^{2+}] = 0.0175 M.$$

(02)

$$\text{Mass of Zn in the ore} = (0.0175 \times 65) = 1.1375 \text{ g}$$

$$\% \text{ purity} = \frac{1.1375}{1.5} \times 100 = \underline{\underline{75.83\%}}$$

$\text{O}_n \text{Z}$

$$(a) \% \text{ O} = 100 - (40 + 6.67) = 53.33\% \checkmark$$

Elements Composition	C 40	H 6.67	O 53.33
Moles	$\frac{40}{12}$ 3.33	$\frac{6.67}{1}$ 6.67	$\frac{53.33}{16}$ 3.33 ✓ (03)
Mole ratio	$\frac{3.33}{3.33}$ 1	$\frac{6.67}{3.33}$ 2	$\frac{3.33}{3.33}$ 1 ✓

Empirical formula is $\underline{\underline{\text{CH}_2\text{O}}}$ ✓

$$\text{Depression in freezing point} = (0 - -3.49) = 3.49^\circ\text{C}$$

(b) 250g of water can dissolve 28.145g of Q

$$1000\text{g of water can dissolve } \left(\frac{1000 \times 28.145}{250} \right) \text{g of Q}$$

$$= 112.58 \text{g of Q.}$$

3.49°C is the depression in freezing point caused by 112.58g of Q.

1.86°C is the depression in freezing point caused by $\left(\frac{1.86 \times 112.5}{3.49} \right)$

$$\therefore (\text{CH}_2\text{O})_n = 60 \checkmark$$

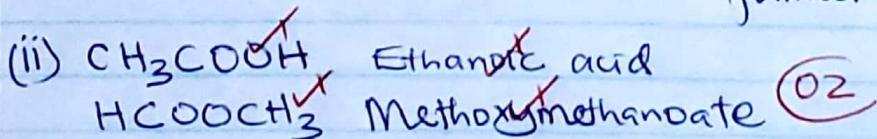
$$12n + 2n + 16n = 60$$

$$n = 2 \checkmark$$

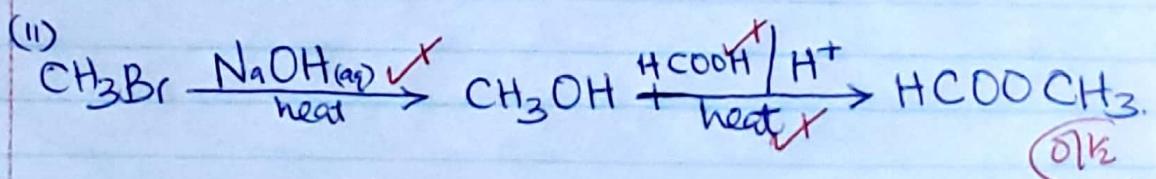
$$\therefore \text{Molecular formula is } \underline{\underline{\text{C}_2\text{H}_4\text{O}_2}}$$

$$= 60 \text{ g/mol}$$

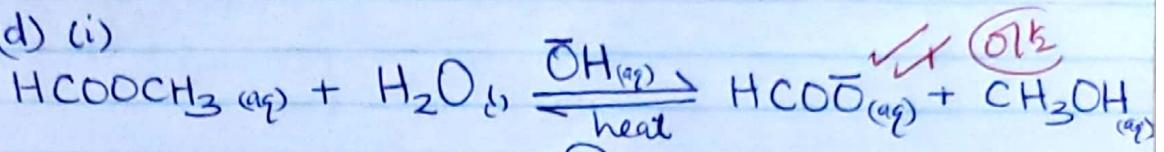
$$(03 \frac{1}{2})$$



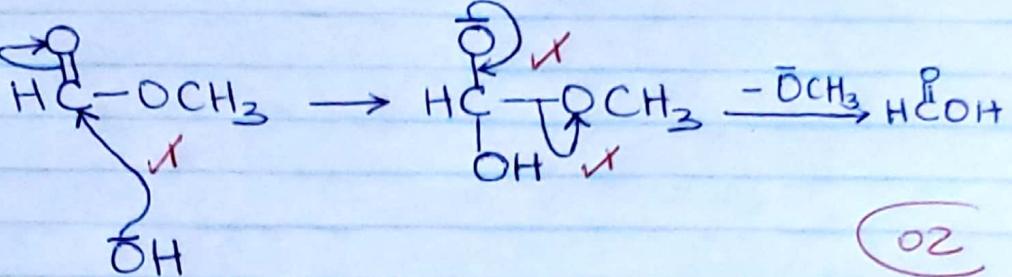
(c) (i) Methoxymethanoate ✓ (02) Rej, HCOOCH_3



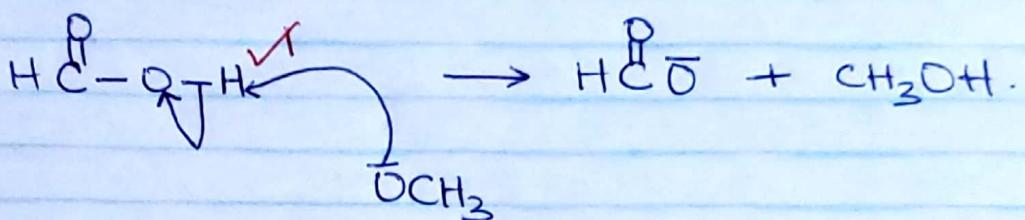
(d) (i)



(ii)

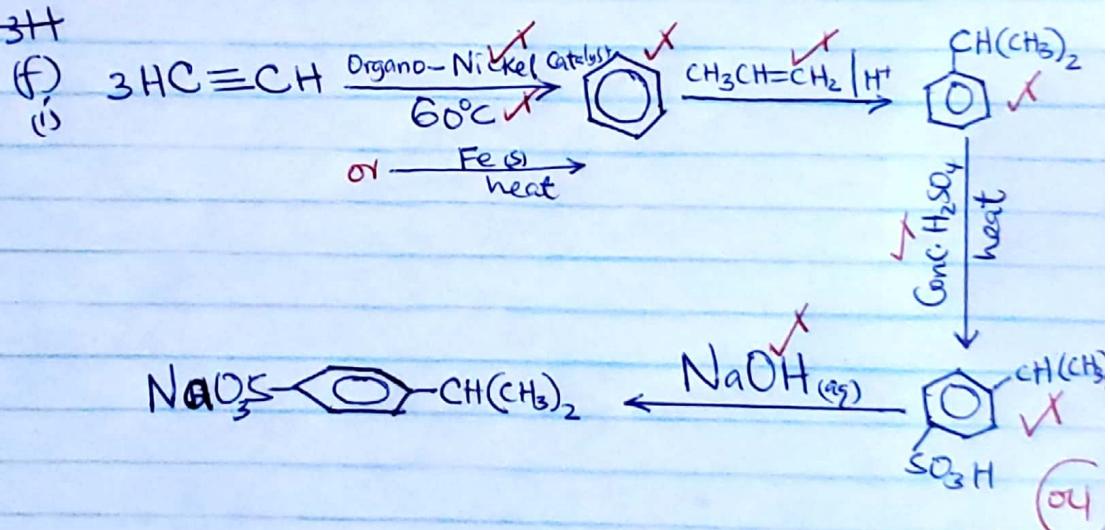


OK



(e) Saponification ; Used in manufacture of soap.

(f) 3H



OK

f (ii) Formation of soaps & detergents.

Advantage

- Does not form scum with hard water.
- Can be used in acidic medium.
- Has a higher cleansing action on clothes.

OK

Disadvantages

- Non biodegradable hence pollutes environment.
- Expensive to manufacture.

Qn 3

(a) (i) Copper cuprites. ✓ (ok)

(ii)

Concentration by froth flotation.

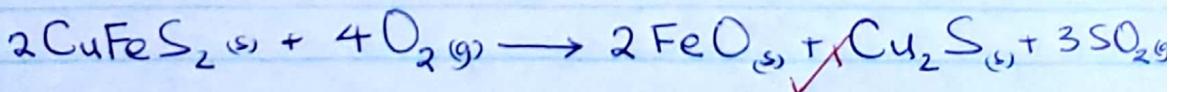
The ore is crushed/pulverized into powder and dissolved in water which wets the impurities and sinks them to the bottom of the container. A frothing agent such as palm oil is added which wet the ore and floats with it to the surface.

Air is blown through the mixture to agitate it as air bubbles rise to the surface with more ore concentrated in the froth which is skinned off, broken with an acid, and the ore is filtered off, washed and dried.

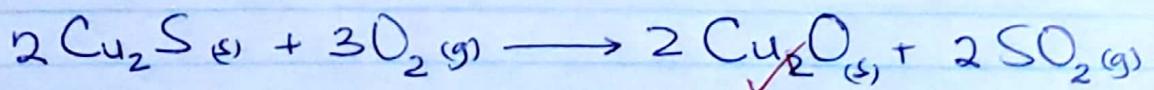
Smelting

The ore is mixed with silicon dioxide and fed into a furnace. Air is blown into the furnace which oxidises iron pyrite to iron(II) oxide and sulphur dioxide and forming copper(II) sulphide

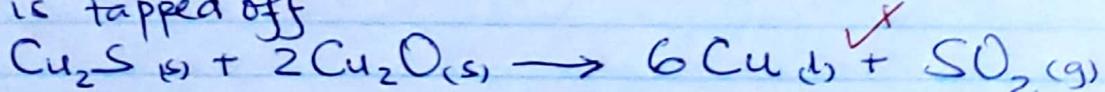
(ok)



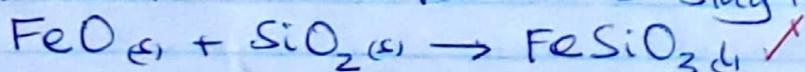
Copper(II) sulphide is oxidised to copper(II) oxide.



The copper(II) oxide formed reacts with the remaining copper(II) sulphide to form molten copper (blister) that is tapped off



The iron(II) oxide reacts with silicon(IV) oxide to form iron(II) silicate which is removed as slag that is tapped off



(b) Copper reacts with hot concentrated hydrochloric acid to form dichlorocuprate(1) ions and hydrogen gas.

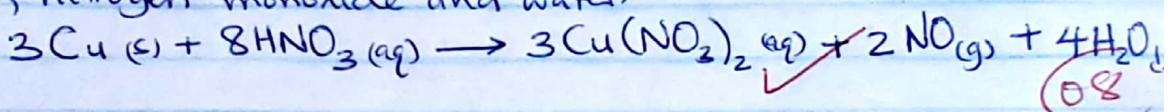
$$2\text{Cu(s)} + 2\text{H}^+(\text{aq}) + 4\text{Cl}^-(\text{aq}) \rightarrow 2\text{CuCl}_2^-(\text{aq}) + \text{H}_2(\text{g})$$

Hot concentrated sulphuric acid oxidises copper to copper(II)-sulphate and itself reduced to sulphur dioxide and water.

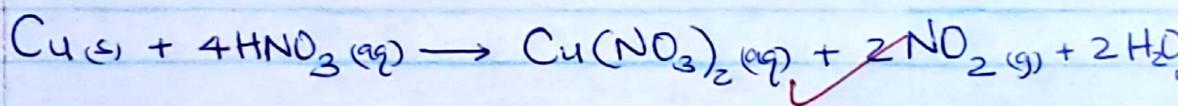
$$\text{Cu(s)} + 2\text{H}_2\text{SO}_4(\text{l}) \rightarrow \text{CuSO}_4(\text{aq}) + \text{SO}_2(\text{g}) + 2\text{H}_2\text{O(l)}$$

$$\text{Gd(s)} + 4\text{H}^+(\text{aq}) +$$

With moderately dilute nitric acid, copper reacts with moderately dilute nitric acid forming Copper(II) nitrate, nitrogen monoxide and water.



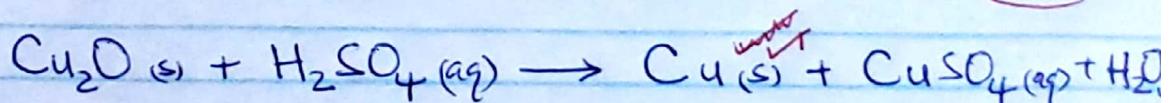
With Copper reacts with cold concentrated nitric acid forming Copper(II) nitrate, nitrogen dioxide and water.



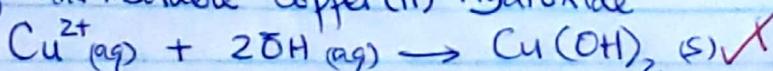
(c)

(i) Red solid dissolves to form a blue solution and a brown solid deposited.

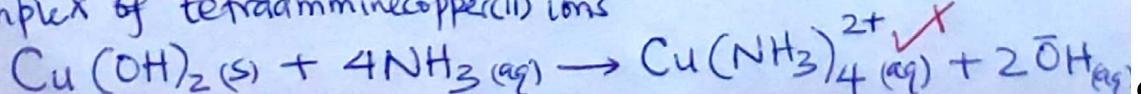
Copper(I) oxide reacts with dilute sulphuric acid to form copper(1) sulphate. The copper(1) ions formed are unstable hence disproportionates to form copper and copper(II) sulphate

02k


(ii) Blue precipitate soluble in excess forming a deep blue solution
Copper(II) ions react with hydroxyl ions from ammonia solution forming an insoluble copper(II) hydroxide


03

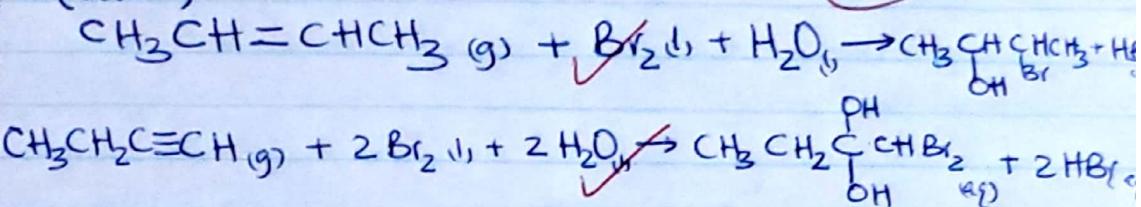
Copper(II) hydroxide reacts with excess ammonia to form a soluble complex of tetraamminecopper(II) ions



Qn 4.

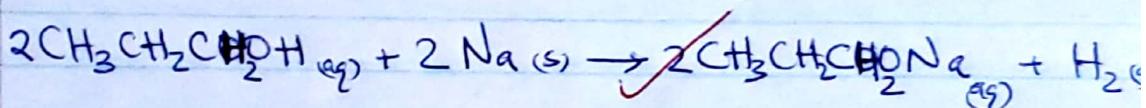
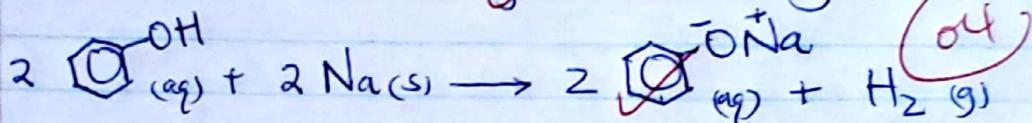
(i) Bromine water.

Observations; Reddish brown solution turns to colourless.
Equation;

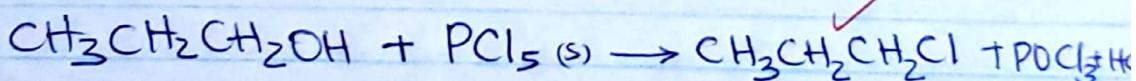
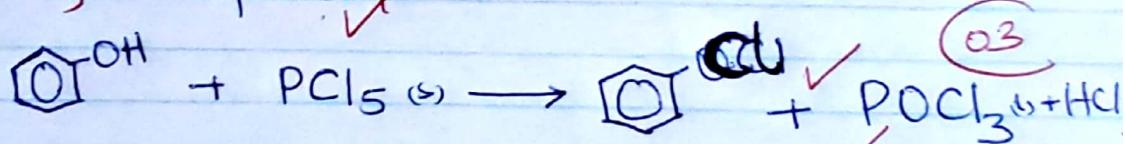


(ii) Sodium metal.

Observations; Bubbles of a colourless gas.

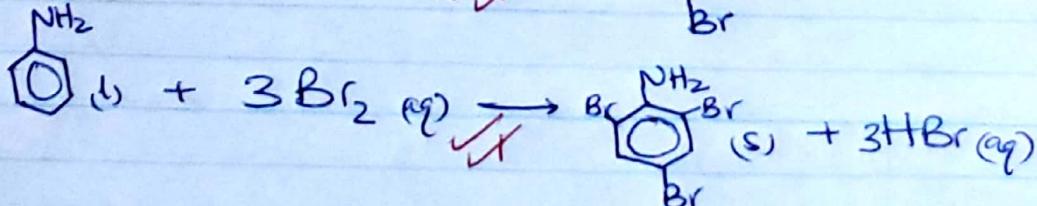
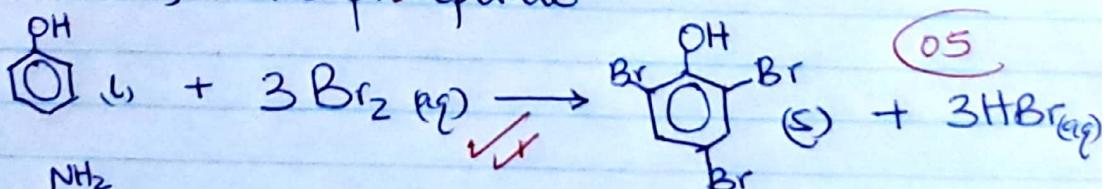


{ Accept; Phosphorus pentachloride
; white fumes



(iii) Bromine water

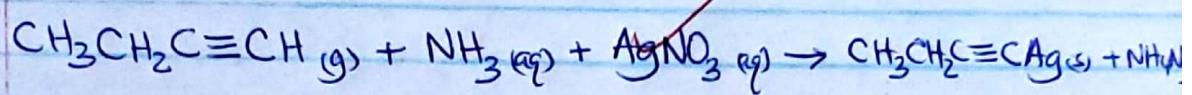
Observation; white precipitate



(b) (i) Ammoniacal silver nitrate solution.

With $\text{CH}_3\text{CH}=\text{CHCH}_3$, No observable change. (04)

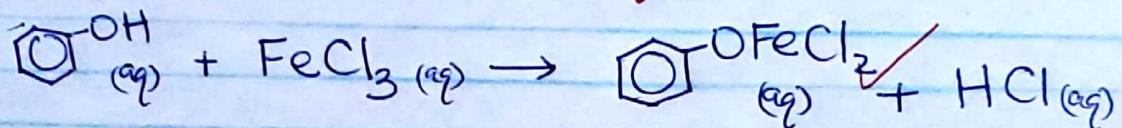
With $\text{CH}_3\text{CH}_2\text{C}\equiv\text{CH}$, white precipitate



(ii) Neutral iron(III) chloride solution.

With $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$, No observable change

With $\text{C}_6\text{H}_5\text{OH}$ purple coloration. (04)



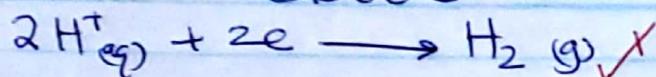
20 MARKS.

Qn 5.

Quantity of substance formed/deposited at the electrode is directly proportional to the current A (01)

Quantity of charge required to deposit one mole of a substance at the electrode is directly proportional to the charge on the ion being discharged. (01)

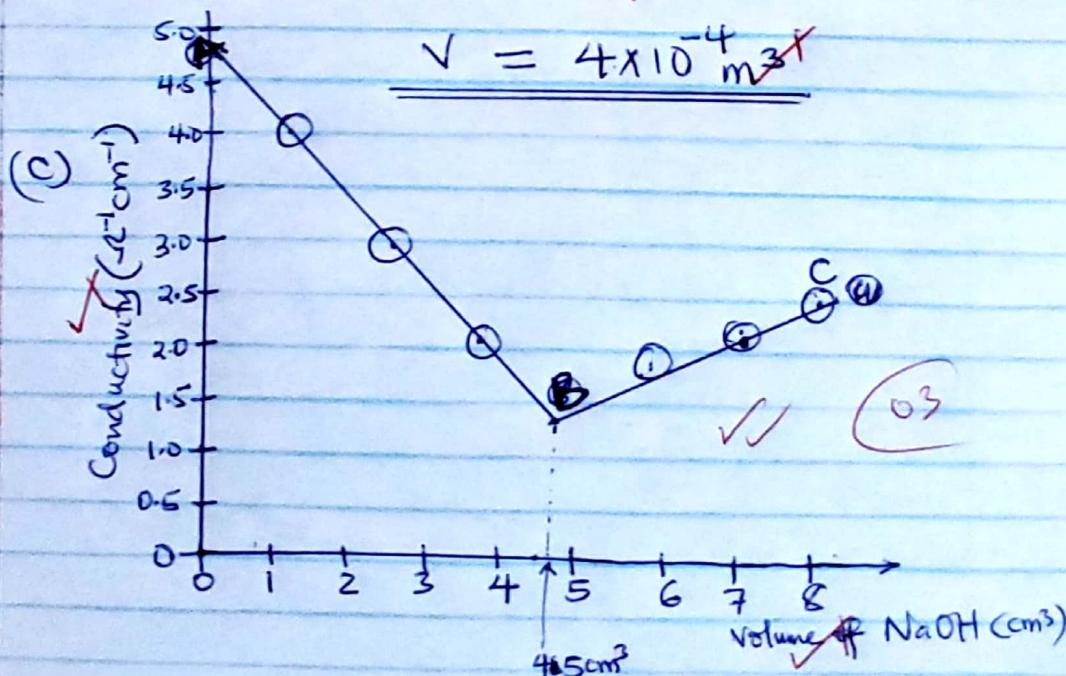
(b) $Q = It$ X
 $= (20 \times 60) \times 3$ X
 $= 3600 \text{ C.}$



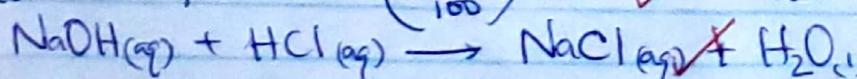
$(2 \times 96500) \text{ C}$ deposit 1 mole of H_2
 3600 C deposit $\frac{(3600 \times 1)}{2 \times 96500}$ moles of H_2
 $= 0.018653$ moles of H_2 X

From $PV = nRT$ X

$$(120 \times 1000) V = 0.018653 \times 8.314 \times 298$$



(iii) Moles of $\text{NaOH} = \left(\frac{4.5 \times 1}{100} \right) = 4.5 \times 10^{-3}$ moles



Mole ratio of $\text{NaOH} : \text{HCl}$ is $1:1$ \therefore Moles of $\text{HCl} = 4.5 \times 10^{-3}$ reacted

500 cm^3 of solution contain 4.5×10^{-3} moles
1000 cm^3 of solution contain $\left(\frac{4.5 \times 10^{-3}}{2} \times 1000 \right) = 0.09 \text{ M.}$

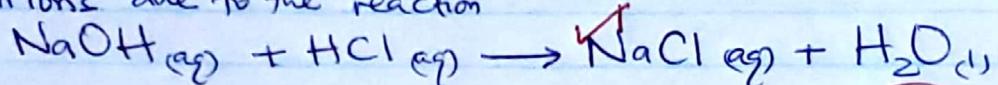
(iii)

A

Initially, conductivity is high due to high concentration of highly mobile and highly conducting hydrogen ions from hydrochloric acid, a strong acid that completely ionises in solution to produce excess hydrogen ions.

Along AB

Conductivity decreases, the highly mobile and conducting hydrogen ions are being replaced by the less mobile Sodium ions due to the reaction



04%

At B

Conductivity is due to sodium and chloride ions formed after complete neutralisation of the acid (at the end point)

Along BC

Conductivity increases; due to Excess hydroxyl ions and the general increase in the number of conducting ions.

The increase in conductivity to excess hydroxyl ions ends at the point lower than A, because they are not as highly conducting and mobile as the hydrogen ions.

$$(d) \text{ Molar mass of } \text{ZnCl}_2 = 64.5 + (35.5 \times 2) \neq 135.5 \text{ g}$$

$$[\text{ZnCl}_2] = C = \left(\frac{2.72}{135.5} \right) \neq 0.02 \text{ M}$$

$$C = \frac{K}{L} \neq$$

$$= \frac{5.175 \times 10^{-3}}{0.02} \times 1000$$

$$L_C = 258.75 \text{ S}^{-1} \text{ cm}^2 \text{ mol}^{-1}$$

03 v2

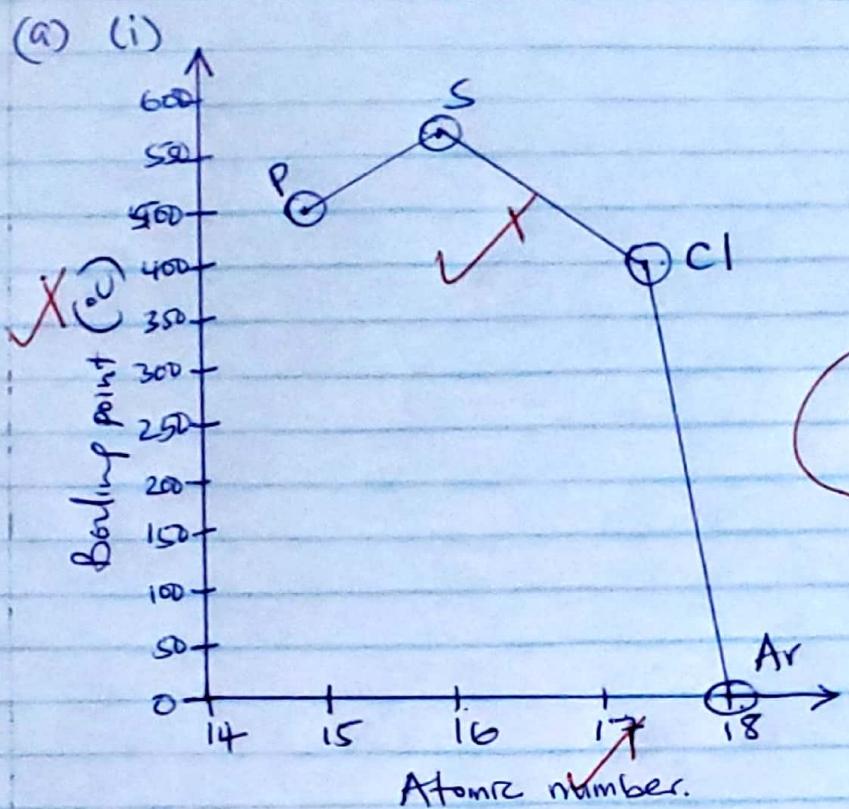
$$L_{\text{ZnCl}_2} = L_{\text{Zn}^{2+}} + 2L_{\text{Cl}^-}$$

$$258.75 = 106 + 2L_{\text{Cl}^-}$$

$$L_{\text{Cl}^-} = 76.375 \text{ S}^{-1} \text{ cm}^2 \text{ mol}^{-1}$$

20 MARKS

Qn 6.



(ii) Boiling points generally decreases from phosphorous to Argon.

This is because they have simple molecular structures with Van der waals forces of attraction which becomes stronger with increase in molecular weight.

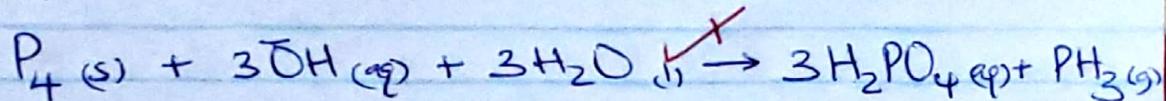
Sulphur is octa atomic, S_8 , with high molecular weight, strong van der waal's forces of attraction hence higher boiling point than phosphorous which is tetratomic, P_4 , with relatively low van der waals forces of attraction hence lower boiling point.

Chlorine is diatomic with relatively low molecular weight, weak van der waals forces of attraction hence low boiling point.

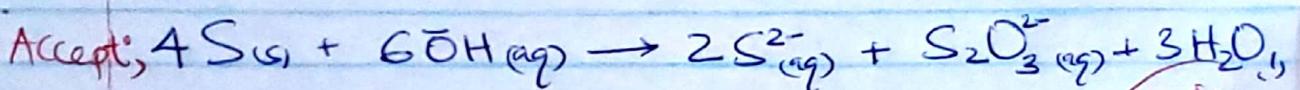
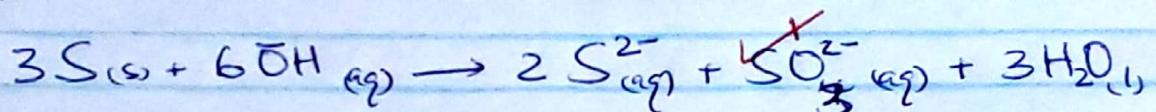
Argon is monatomic, Ar , with very low molecular weight, very weak (negligible) van der waals forces of attraction hence very low boiling point.

(b) (i)

Phosphorus reacts with hot concentrated sodium hydroxide solution to form phosphine gas and sodium phosphinate

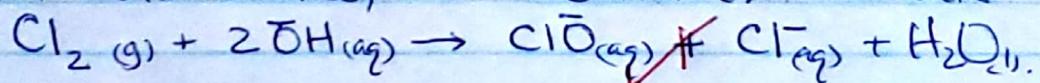


Sulphur reacts with hot concentrated sodium hydroxide solution to form sodium sulphide, sodium thiosulphate or sodium sulphite and water

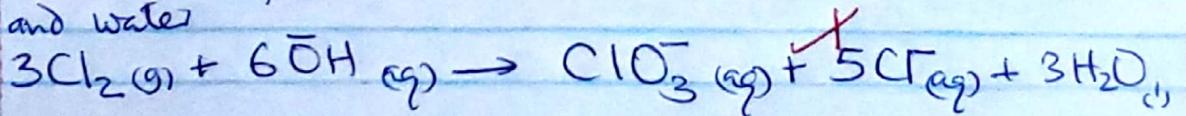


05%

Chlorine reacts with cold dilute sodium hydroxide solution to form sodium chloride, sodium chlorate(I) and water.



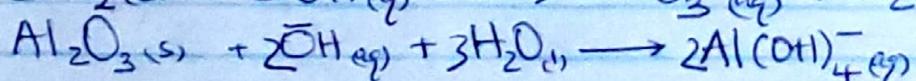
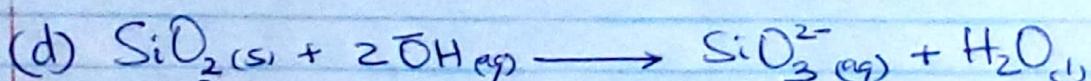
Chlorine reacts with hot concentrated sodium hydroxide solution to form sodium chloride, sodium chlorate(V) and water



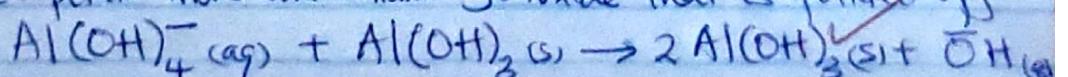
(c) (i) To remove water of crystallisation to obtain anhydrous aluminium oxide, and to oxidise iron(II) ~~to~~ to iron(III) oxide
05%
(ii) To remove ~~impurity~~ iron(III) oxide and titanium(IV) oxide impurities.

05%

05%



(e) The filtrate is seeded with freshly prepared aluminium hydroxide to precipitate more aluminium hydroxide that is filtered off



Accept: $\frac{1}{2}$ by bubbling carbon dioxide through the filtrate to precipitate aluminium hydroxide



Aluminium hydroxide filtered off is strongly heated to obtain aluminium oxide



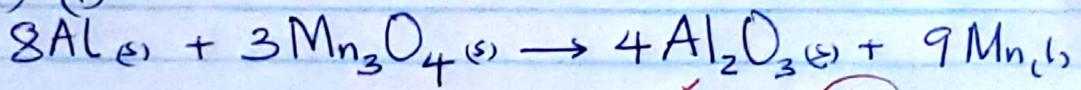
Aluminium oxide formed is electrolysed between graphite electrodes in presence of molten cryolite to lower the melting point of aluminium oxide. Electrolysis occurs at low voltage and high current density.

0.5V

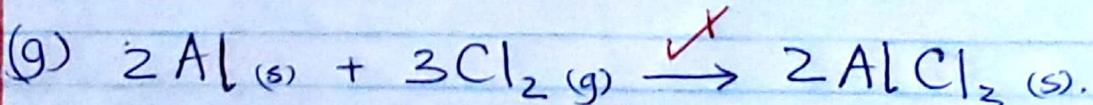
At Cathode



(f) (i)



(ii) Reduction \checkmark 0.5V

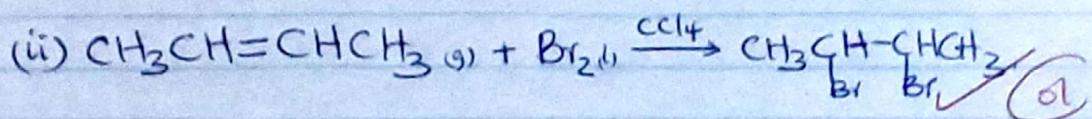


0.5V

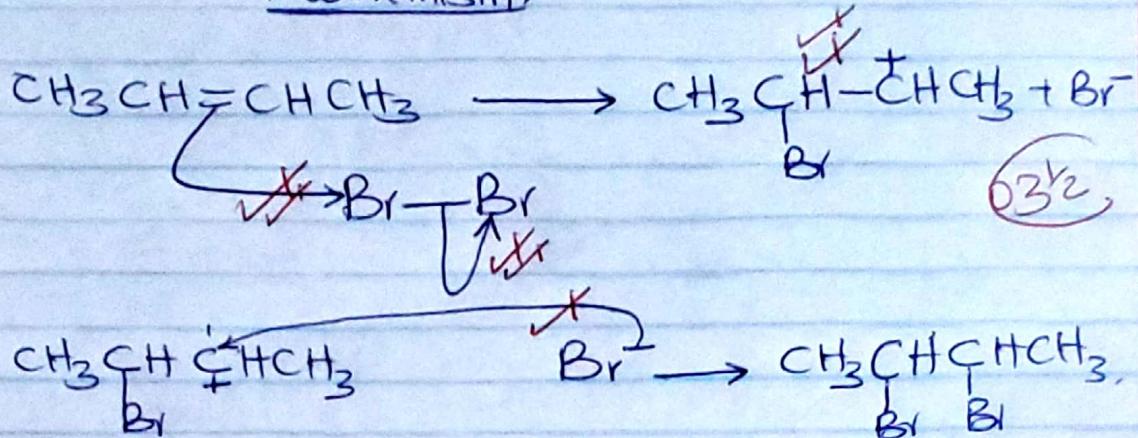
20 MARKS.

Qn 8

(a) (i) Reddish brown solution turns to colourless. (01)



Mechanism.



Molar mass of $\text{Br}_2 = (80 \times 2) = 160 \text{ g.}$

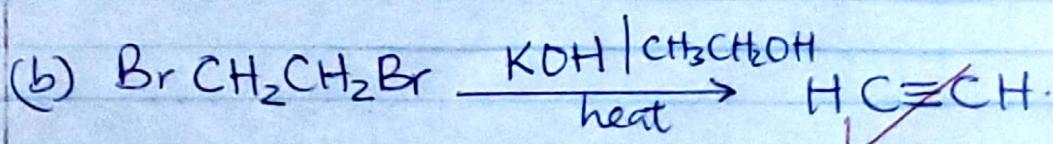
(ii) Moles of $\text{Br}_2 = \left(\frac{80}{160}\right) = 0.5 \text{ moles.}$

From the equation, Mole ratio of $\text{CH}_3\text{CH}=\text{CHCH}_3 : \text{Br}_2 : \text{CH}_3\text{CH}=\text{CHCH}_3$ is 1:1:1
Moles of $\text{CH}_3\underset{\text{Br}}{\underset{\text{Br}}{\text{C}}} \text{H}-\text{CHCH}_3 = 0.5 \text{ moles.}$ (01)

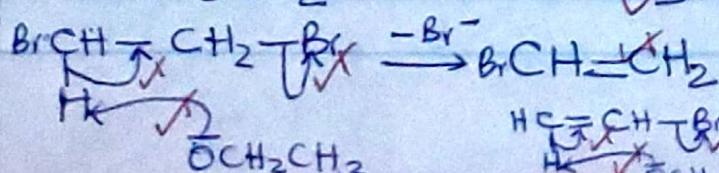
Molar mass of $\text{CH}_3\underset{\text{Br}}{\underset{\text{Br}}{\text{C}}} \text{H}-\text{CHCH}_3 = (12 \times 4) + (8 \times 1) + (80 \times 2) = 226 \text{ g.}$

\therefore Mass of $\text{CH}_3\underset{\text{Br}}{\underset{\text{Br}}{\text{C}}} \text{H}-\text{CHCH}_3 = (0.5 \times 226) = 113 \text{ g.}$

(iv) % yield = $\frac{43.2}{113} \times 100 = 38\%$ (01)



Mechanism.



(05)

(c) Ethyne is reacted with Sodium metal in presence of liquid ammonia followed by bromomethane to form propyne.

Propyne is reacted with mercury (II) Sulphate solution in presence of Concentrated Sulphuric acid and water and mixture heated at 60°C to form propanone.

04