

Marking Guide

Uganda Advanced Certificate of Education

CHEMISTRY

PAPER 2

2 hours 30 minutes

INSTRUCTIONS TO THE CANDIDATES

- Answer **five** questions including **three** questions in section **A** and any **two** questions in section **B**.
- Write the answers in the answer booklet provided.
- Mathematical tables and graph papers are provided.
- Begin each question on a fresh page.
- Non-programmable scientific electronic calculators may be used.
- Illustrate your answers with equations where applicable.
- Indicate the questions in the grid below.
- Where necessary use $C = 12, O = 16, H = 1$
- Molar gas volume is 22.4 dm^3 at s.t.p
- 1 atmosphere = 101325 N m^{-2}

Question						Total
Marks	20%	20%	20%	20	20	100%
	20	20	20	20	20	<u> </u>

SECTION A
Attempt only **three** questions.

1. (a) Write the electronic configuration of manganese (Atomic number = 25)
 (b) Explain why manganese is
 (i) a transition element. (01mark)
 (ii) has variable oxidation states. (02marks)
 (iii) has a high melting point (1890°C) compared to calcium with melting point (860°C) (03marks)
- (c) Describe how manganese reacts with
 (i) water (2½marks)
 (ii) sulphuric acid (4½marks)
- (d) Aqueous sodium hydroxide solution was added to manganese(II) sulphate solution dropwise until in excess and the resultant mixture allowed to stand.
 (i) State what was observed. (1½marks)
 (ii) Write equation(s) for the reaction(s) that took place. (03marks)
 (e) Write equation for the reaction between trimanganese tetroxide (Mn_3O_4) and aluminium (1½marks)

2. The table below shows the variation in pH when 30cm^3 of 0.2M ammonia solution was titrated with hydrochloric acid.

Volume of HCl added (cm^3)	0	4	8	12	16	18	19	19.4	19.8
pH	10.8	9.9	9.4	9.1	8.7	8.3	8.0	7.8	7.3

20.2	20.6	21	22	26	28
3.9	3.5	3.2	2.9	2.5	2.4

- (a) Plot a graph of pH against volume of hydrochloric acid. (04marks)
- (b) Use the graph to determine the:
 (i) pH and volume at the end point. (02marks)
 (ii) molarity of hydrochloric acid (02marks)
 hydrolysis constant of ammonium chloride formed at the end point. (3½marks)
 (iii) ratio of $[\text{NH}_4\text{Cl}]: [\text{NH}_3]$ when 10cm^3 of hydrochloric acid has been added to ammonia solution. (2½marks)
 (K_b for ammonia = $1.78 \times 10^{-5}\text{mol dm}^{-3}$, K_w = $1 \times 10^{-14}\text{mol}^2\text{dm}^{-6}$)
- (c) Explain the shape of the graph. (05marks)
- (d) Which of the indicators shown below is suitable for the titration. Give a reason for your answer.

Indicator	pH range
Thymol blue	1.2 – 2.8
Methyl orange	3.1 – 4.4
Methyl red	4.2 – 6.3
Phenolphthalein	8.3 – 10.0

3. When 7.5g of an organic compound Q was burnt completely in excess oxygen, 11.2dm^3 of carbon dioxide and 4.5g of water were formed at s.t.p.
- (a) (i) Calculate the empirical formula of Q. (3½marks)
 (ii) Determine the molecular formula of Q (Density of Q is 5.357g dm^{-3} at s.t.p) (02mark)

Q burns with a sooty flame and forms a yellow precipitate with 2,4-dinitrophenylhydrazine and also forms a pale yellow precipitate with iodine solution in sodium hydroxide solution. Identify **Q**. (0½mark)

- (c) Write equation and suggest a mechanism for the reaction between **Q** and
 (i) 2,4-dinitrophenylhydrazine in acidic medium. (4½marks)
 (ii) sodium hydrogen sulphite solution (03marks)
- (d) Using equations only show how **Q**
 (i) can be synthesized from benzaldehyde (04marks)
 (ii) can be converted to a an alkene (2½marks)
4. (a) (i) State Le Chatelier's principle. (01mark)
 (ii) State **two** factors that affect equilibrium reactions apart from catalyst. (02marks)
 (iii) Briefly describe how each of the factors you have named in (a)(i) affect the equilibrium constant and equilibrium position. (05marks)
- (b) Given the reaction $\text{Ni}(\text{CO})_4(\text{g}) \rightleftharpoons \text{Ni}(\text{s}) + 4\text{CO}(\text{g})$
 (i) Write the expression for the equilibrium constants K_c and K_p giving units in each case. (03marks)
 (ii) What is the effect on position of equilibrium of adding a catalyst. (01mark)
- (c) COCl_2 dissociates according to the following equation.

$$\text{COCl}_2(\text{g}) \rightleftharpoons \text{CO}(\text{g}) + \text{Cl}_2(\text{g})$$
- (i) At 25°C , one mole of COCl_2 was placed in 2dm^3 vessel producing an equilibrium mixture with 20.25% chlorine. Calculate the value of the equilibrium constant K_c at this temperature. (03marks)
 (ii) At 75°C , the degree of dissociation of 2 moles of COCl_2 in the same 2dm^3 vessel was found to be 15%. Calculate the value of the equilibrium constant K_c at this temperature. (03marks)
- (iii) From your answer in (c)(i) and (c) (ii) above, state whether the reaction is exothermic or endothermic. Give a reason for your answer. (02marks)

SECTION B

Attempt any **two** questions from this section.

5. Write equations to show how the following conversions can be effected.
- (a) Bromo benzene from phenol (3½marks)
 (b) Propanal from chloroethane (05marks)
 (c) Phenylamine from methylbenzene (05marks)
 (d) Hexane from propene (2½marks)
 (e) $(\text{CH}_3)_2\text{C} = \text{NCH}_2\text{CH}_2\text{CH}_3$ from 2-iodopropane (04marks)
5. (a) Define the following terms.
 (i) Lattice energy
 (ii) Hydration energy.
 (b) Given the following thermodynamic data. (02marks)

Standard enthalpy of formation of aluminium fluoride
 Standard enthalpy of atomization of aluminium
 Standard enthalpy of bond dissociation of fluorine gas
 First ionization energy of aluminium
 Second ionization energy of aluminium
 Third ionization energy of aluminium
 First electron affinity of fluorine

= -1301 kJmol⁻¹
 = +314 kJmol⁻¹
 = +158 kJmol⁻¹
 = +577 kJmol⁻¹
 = +1820 kJmol⁻¹
 = +2740 kJmol⁻¹
 = -348 kJmol⁻¹

- (i) Draw an energy level diagram for the formation of aluminium fluoride and use it to determine the lattice energy of aluminium fluoride. (06mks)
- (ii) Given that the hydration energies of aluminium ions and fluoride ions are -4690 and -364 kJmol⁻¹ respectively. Calculate the enthalpy of solution of aluminium fluoride and hence comment on its solubility in water. (04marks)
- (d) State and explain **two** factors that affect the lattice energy. (06marks)
- (e) Would you expect the lattice energy of aluminium chloride to be less than, greater than or equal to that of aluminium fluoride. Explain your answer. (04marks)

7. The table below shows the hydrides of group(VII) elements and their boiling points .

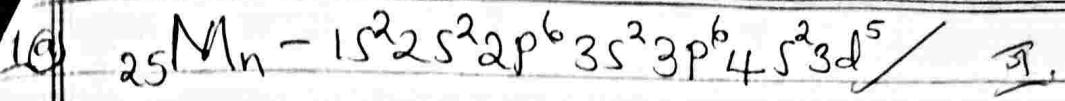
Period number	2	3	4	5
Hydride	HF	HCl	HBr	HI
Boiling point (°C)	+20	-85	-67	-35

- (a) (i) Plot a graph of boiling point against period number. (04marks)
 (ii) Explain the shape of the graph (05marks)
- (b) Describe briefly how the following hydrides are prepared in the laboratory .(Illustrate your answer with an equation).
 (i) Hydrogen chloride
 (ii) hydrogen iodide (2½marks) (2½marks)
- (c) Discuss the reactions of the hydrides with
 (i) sodium hydroxide
 (ii) sulphric acid
 (iii) Silicon dioxide (06marks)

8. (a) Explain the following processes as used in the extraction of metals
 (i) Floatation
 (ii) Roasting
 (iii) Smelting (12marks)
- (b) Briefly describe how the ore of aluminium can be concentrated.(08mks)

END

W,



(i) Manganese is a transition element since it forms a stable ion in one of the oxidation states with a partially filled 3d-orbital. 3.

(ii) Manganese has variable oxidation states because it has a very small energy difference between the 4s² and 3d orbitals hence it can easily lose both the 4s² and 3d⁵ electrons during ionization thus the very many oxidation states.

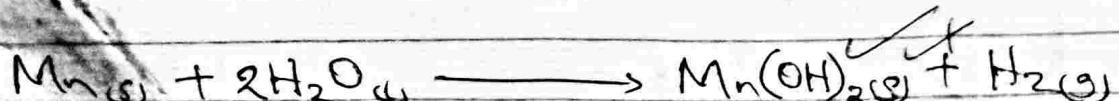
(iii) Melting points of metals depend on the atomic radius and number of electrons contributed into the electron cloud towards metallic bond formation.

Manganese has a smaller atomic radius than Calcium (0.17 nm) and contributes both the 4s and 3d-orbital electrons towards metallic bond formation unlike Calcium of higher atomic radius (of 0.174 nm) and uses only the s-orbital electrons for metallic bond formation. Thus Manganese has a higher melting point than Calcium.

D. i) Reaction with water:

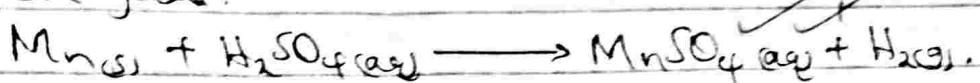
Heated manganese reacts with steam

Manganese reacts with hot water to form manganese(II) hydroxide and hydrogen gas.

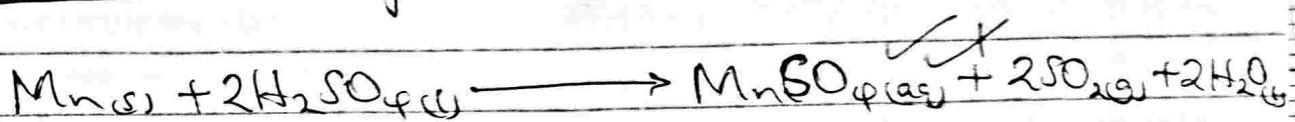


(ii) With sulphuric acid:

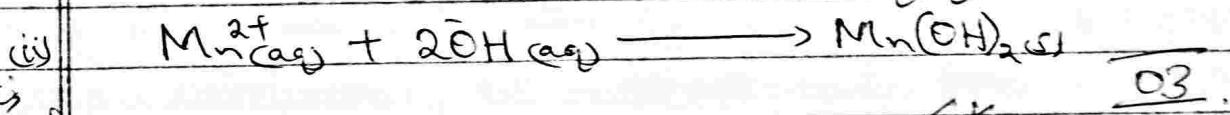
Manganese reacts with dilute sulphuric acid to form manganese(II) sulphate and hydrogen gas.



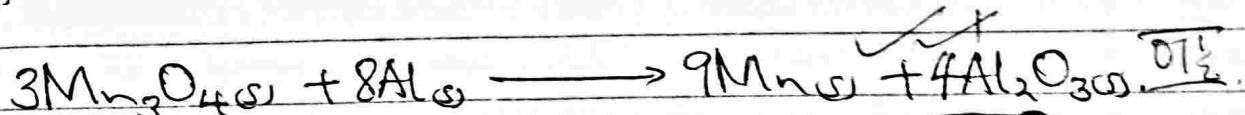
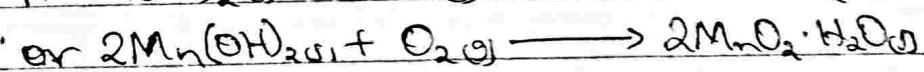
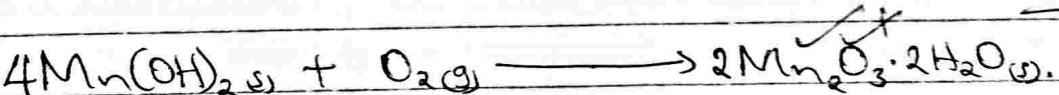
Manganese is oxidized by hot concentrated sulphuric acid to manganese(II) sulphate and the acid reduced to sulphur dioxide and water.



d) White precipitate insoluble in excess that turns brown on standing.



~~Reject~~
* Unbalanced equation
* Begins with physical symbols.
* Known e).



20
20

2(a) Check on graph paper.

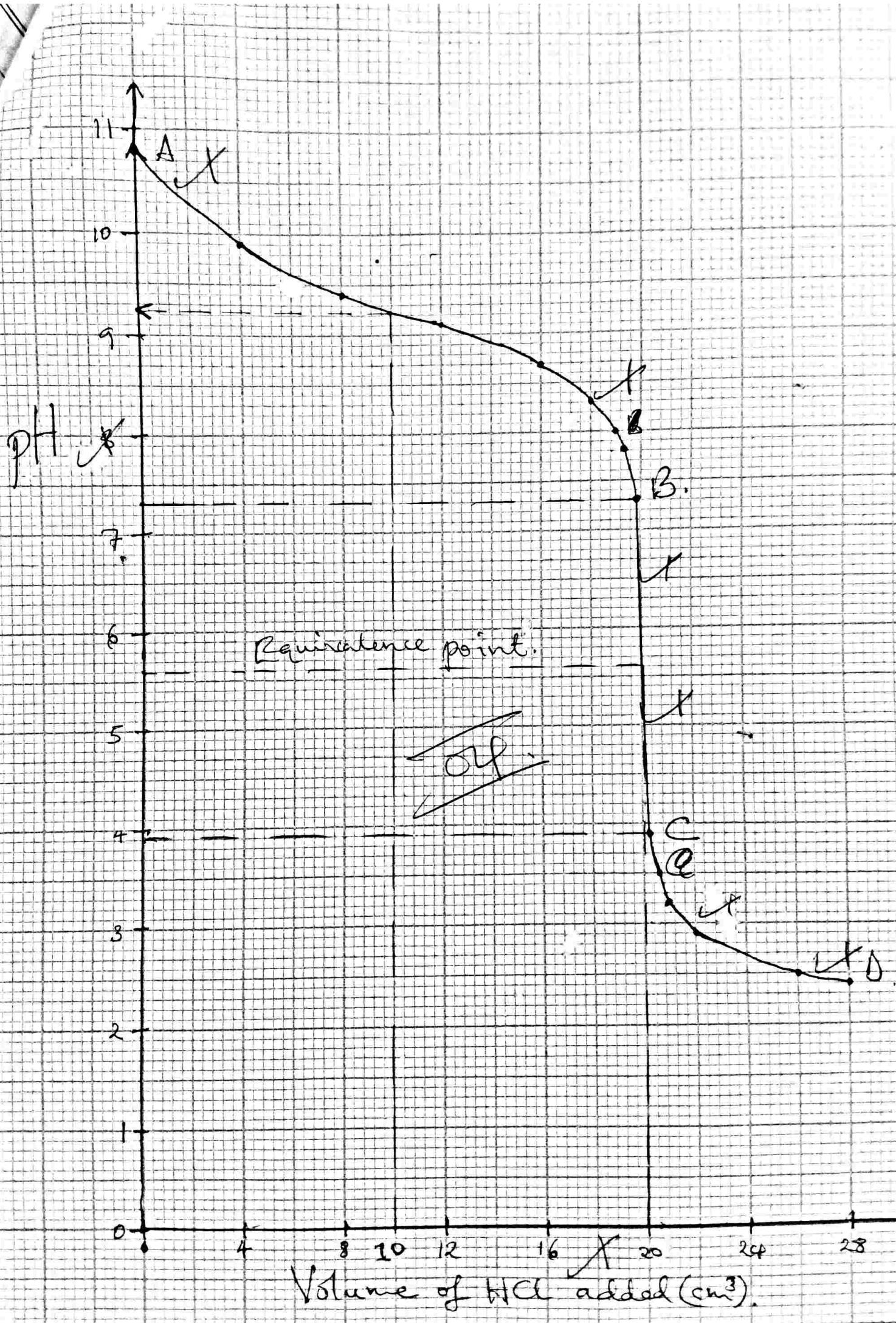
b) ~~pH~~ at

$$\text{End-point pH} = \frac{7.3 + 3.9}{2} = 5.6 \pm 0.1$$

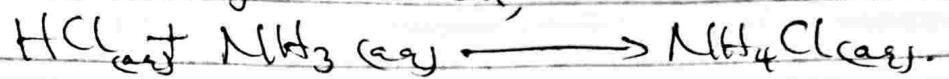
D.

$$\text{End-point volume of HCl} = 20.0 \text{ cm}^3 \pm 0.5$$

$$\text{(ii) Moles of ammonia} = \frac{0.2 \times 30}{1000}$$



Equation of reaction;



1 mole of ammonia reacts with 1 mole of acid.

6.0x10³ moles of ammonia react with 6.0x10³ moles of acid.

But also

20.0cm³ of acid contain 6.0x10⁻³ moles

1000cm³ of acid contain $6.0 \times 10^{-3} \times \frac{1000}{20.0}$

1000cm³ of acid contain 300 moles

∴ Molarity of HCl = 0.3M

Hydrolysis constant, K_h of NH₄Cl.

Rexn for hydrolysis;



$$K_h = \frac{[\text{NH}_3][\text{H}_3\text{O}^+]}{[\text{NH}_4^+]}$$

At the end point (or equilibrium);

$$[\text{NH}_3] = [\text{H}_3\text{O}^+]$$

$$K_h = \frac{[\text{H}_3\text{O}^+]^2}{[\text{NH}_4^+]}$$

At the end point;

$$\text{pH} = -\log_{10}[\text{H}_3\text{O}^+]$$

$$5.6 = -\log_{10}[\text{H}_3\text{O}^+]$$

$$[\text{H}_3\text{O}^+] = 10^{-5.6} = 2.5129 \times 10^{-6} \text{ mol dm}^{-3}$$

F Also, at the end;

$$[NH_4^+] = [NH_4Cl];$$

$$\text{Moles of } \text{NH}_3 \text{ at the endpoint} = \frac{0.2 \times 30}{1600}$$

$$\text{Moles of } \text{N}(\text{H}_4)\text{Cl} = \text{Moles of } \text{NH}_3$$

at the endpoint at endpoint

$$= \frac{0.2 \times 30}{1000}$$

$$\begin{aligned}\text{Total volume of solution} &= 30 + 20 \\ &= 50 \text{ cm}^3.\end{aligned}$$

$$\text{Molarity of } \text{NH}_4\text{Cl} = \frac{0.2 \times 30}{1000} \times \frac{1000}{50}$$

at end point

$$= \underline{\underline{0.12M}}$$

$$\Rightarrow K_h = \frac{(2.5119 \times 10^{-6})^2}{0.2} \quad \boxed{03\frac{1}{2}}$$

$$= 5.258035 \times 10^{-11} \text{ ms}^2 \text{ dm}^{-3}$$

$$K_h = \underline{\underline{5.258 \times 10^{-11} \text{ mol dm}^{-3}}}$$

(iii) When 10.0cm^3 of HCl had been added; all the 10.0cm^3 of 0.3M HCl reacted with part of the NH_3 . 30cm^3 of 0.2M NH_3 and some ~~over~~ NH_3 remained unreacted together with salt, NH_4Cl ~~formed~~ produced formed a basic buffer.

When 10cm^3 of HCl had been added, $\text{pH} = 9.25 \pm 0.1$
Hence;

$$\text{pH} = \text{pK}_w - \text{pK}_b + \log_{10} \frac{[\text{NH}_3]}{[\text{NH}_4^+]}$$

$$\text{But pH} = 9.25, \text{ pK}_w = -\log_{10} 1.0 \times 10^{-14} = 14 \\ \text{pK}_b = -\log_{10} 1.78 \times 10^{-5} = 4.7496$$

$$\Rightarrow 9.25 = 14 - 4.7496 + \log_{10} \frac{[\text{NH}_3]}{[\text{NH}_4^+]}$$

$$\Rightarrow \log_{10} \frac{[\text{NH}_3]}{[\text{NH}_4^+]} = 9.25 - 9.2504 \\ = -0.0004$$

$$\Rightarrow \frac{[\text{NH}_4\text{Cl}]}{[\text{NH}_3]} = 10^{-0.0004} = 1.00092$$

$$\therefore [\text{NH}_4\text{Cl}] : [\text{NH}_3] = 1.0009 : 1.$$

or

At 10cm^3 of HCl, $\text{pH} = 9.25$

using

$$\text{pH} = -\log_{10} [\text{H}_3\text{O}^+]$$

$$\Rightarrow [\text{H}_3\text{O}^+] = 10^{-9.25} = 5.6234 \times 10^{-10} \text{ mol dm}^{-3}$$

$$\text{From } K_w = [\text{H}_3\text{O}^+][\text{OH}^-]$$

$$[\text{OH}^-] = \frac{K_w}{[\text{H}_3\text{O}^+]} = \frac{1.0 \times 10^{-14}}{5.6234 \times 10^{-10}} = 1.77828 \times 10^{-5} \text{ mol dm}^{-3}$$

Hence from;

$$K_b = \frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{NH}_3]}$$

$$\frac{[\text{NH}_4^+]}{[\text{NH}_3]} = \frac{K_b}{[\text{OH}^-]} = \frac{1.78 \times 10^{-5}}{1.77828 \times 10^{-5}}$$

$$= 1.0009676$$

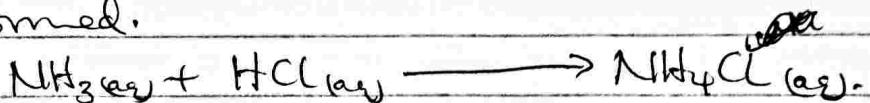
~~0.22~~

$$\underline{[\text{NH}_4^+]:[\text{NH}_3] = 1.001:1}$$

c). Explanation of the shape of graph:

Initially at A, the pH is still high due to high concentration of ammonia.

Along AB, pH gradually decreases because ammonia is being neutralized by the acid added. The decrease is ~~little~~ gradual because ammonia is still in excess and ~~so~~ forms a basic buffer with the ammonium chloride formed.



The end point occurs at B, at the end point, a small amount of acid added causes a sharp decrease in pH.

pH at the end point is below 7 because ammonium chloride formed undergoes hydrolysis to form an acidic solution.



Along CD; There is a decrease in pH due to very many hydrogen ions from the excess acid added.

d) Methyl red!

Because the pH at the end point lies between the pH working range of methyl red indicator.

~~20/20~~

$$\text{Mass of } \text{CO}_2 = \frac{11.2}{22.4} \times 44 \text{ g}$$

$$\begin{aligned}\text{Mass of Carbon, C} &= \frac{12}{44} \times \frac{11.2}{22.4} \times 44 \text{ g} \\ &= 6.0 \text{ g.}\end{aligned}$$

$$\text{Mass of Hydrogen} = \frac{2}{18} \times 44 \text{ g} = 0.5 \text{ g}$$

$$\begin{aligned}\text{Mass of Oxygen} &= 7.5 - (6.0 + 0.5) \\ &= 1.0 \text{ g.}\end{aligned}$$

Elements	C	H	O	
Mass (g)	6.0	0.5	1.0	<u>0.51/2</u>
Number of Moles	<u>6.0</u> / <u>12</u>	<u>0.5</u> / <u>1</u>	<u>1.0</u> / <u>16</u>	

$$\begin{array}{cccc} \text{Mole ratio} & 0.5 & 0.5 & 0.0625 \\ & 0.0625 & 0.0625 & 0.0625 \end{array}$$

$$\text{Simplest ratio} \quad 8 \quad 8 \quad 1$$

\Rightarrow Empirical formula of Q is $\text{C}_8\text{H}_8\text{O}^+$

(ii) To determine molecular mass of Q;

1 dm³ of Q weighs 5.357 g at s.t.p

$$22.4 \text{ dm}^3 \text{ of Q weigh } 5.357 \times 22.4 \text{ g at s.t.p} \\ = 119.9968$$

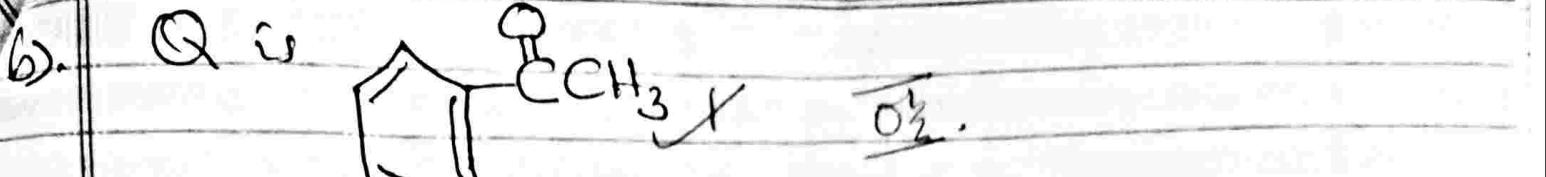
$$\Rightarrow \text{Molecular mass of Q} = 120.0 \text{ g mol}^{-1}$$

$$n = \frac{120}{(8 \times 12) + (8 \times 1) + (1 \times 16)} = 1.$$

∴

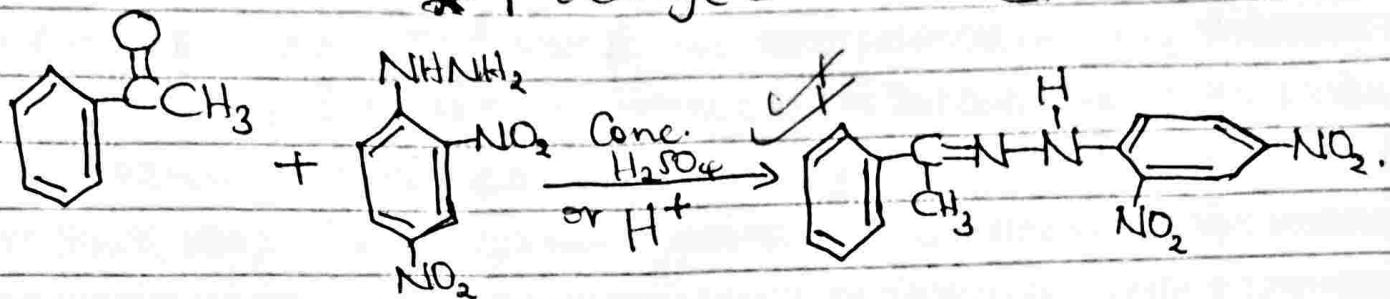
$$\text{Molecular formula} = (\text{C}_8\text{H}_8\text{O})^+$$

$$= \text{C}_8\text{H}_8\text{O}^+$$

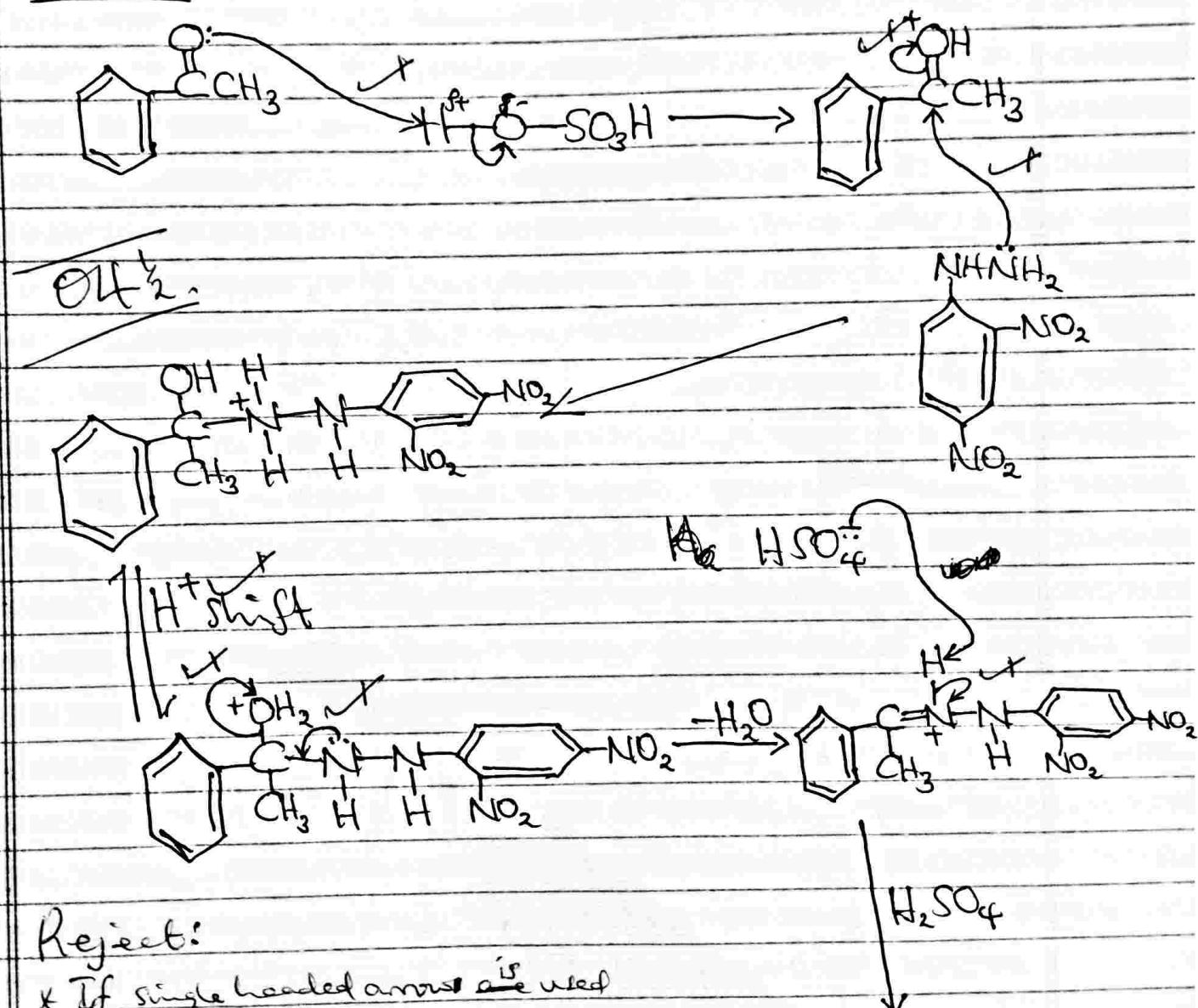


* Phenylethanone.

Q is



Mech:

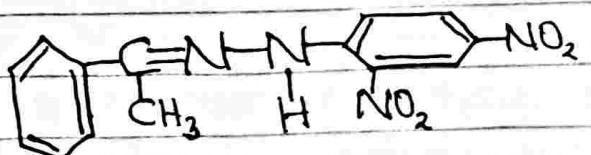


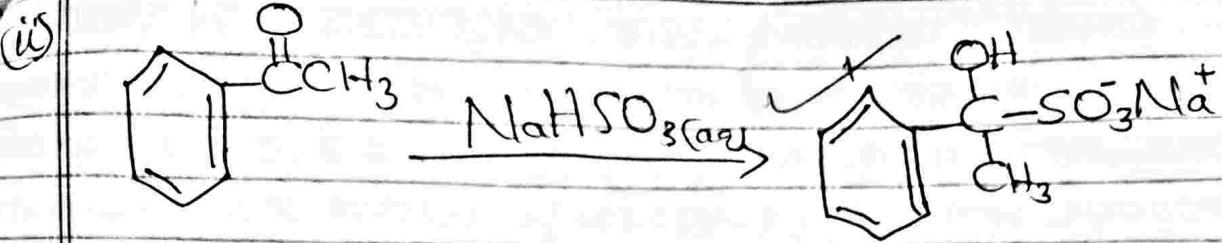
Reject:

* If single headed arrows are used

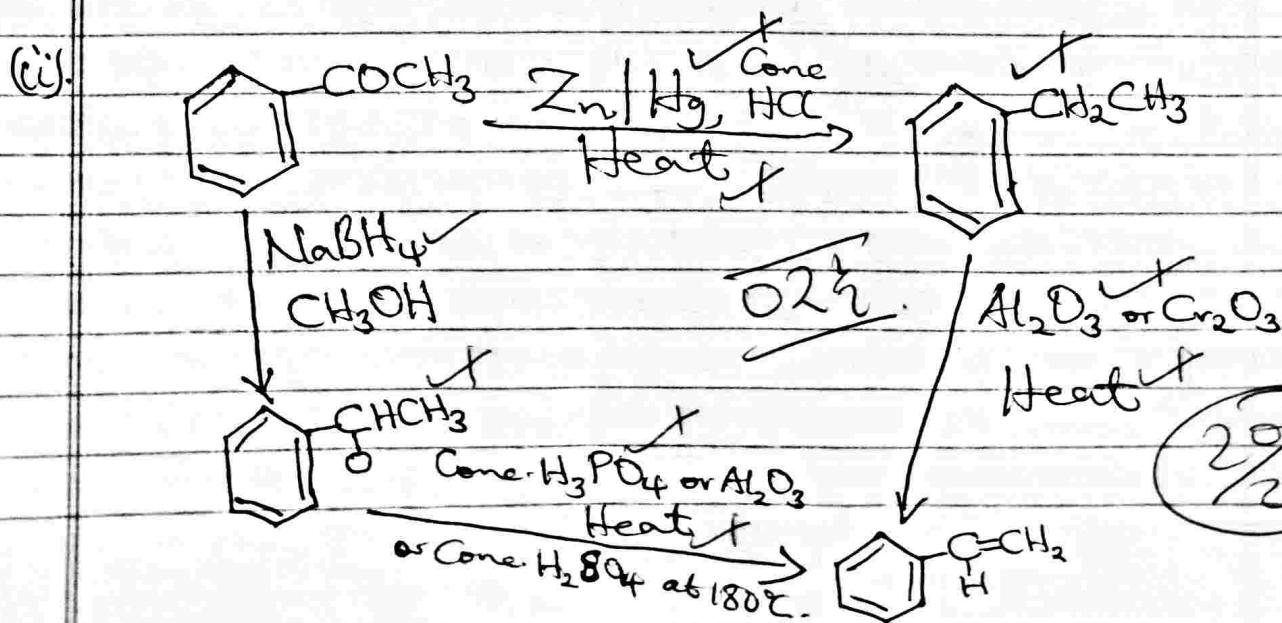
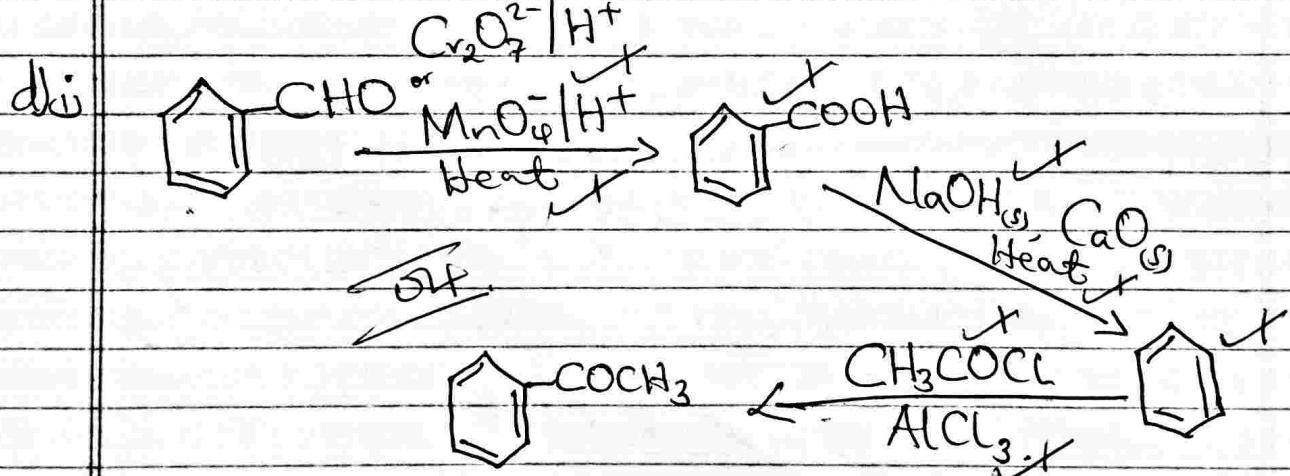
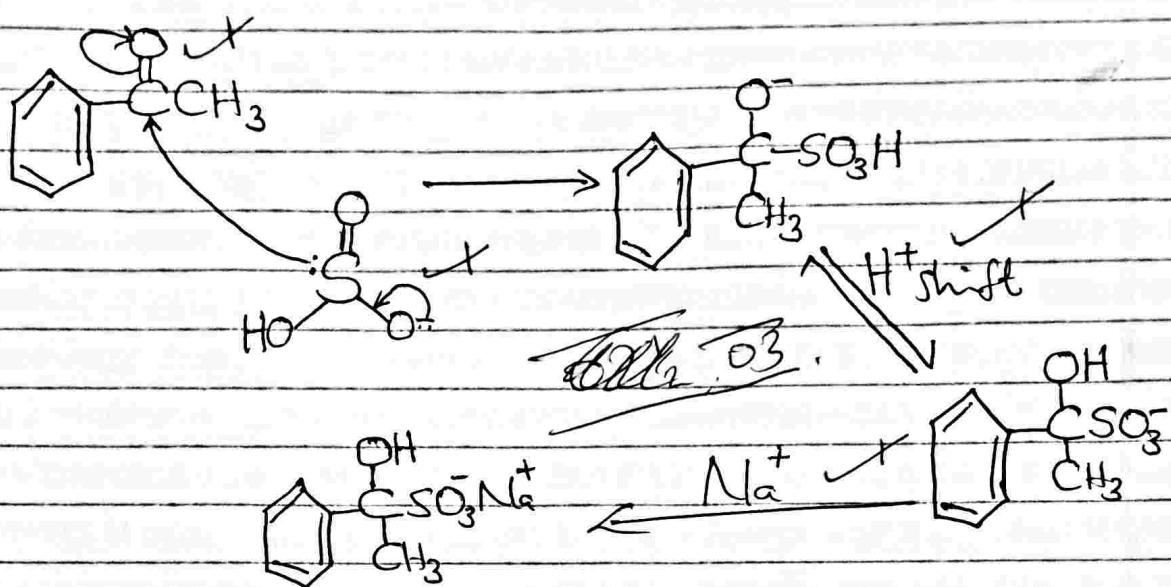
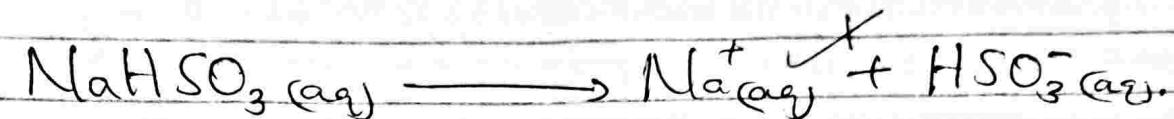
* Wrong formula/symbol used.

* Lone pair of electrons not seen and arrow not in the middle.





Mech:

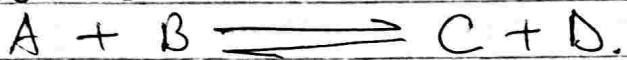


Le Chatelier's principle states that when a system at equilibrium is subjected to a change of any ~~an~~ one of the factors such ~~as~~ of concentration, temperature, pressure, etc., the system ~~adjusts itself~~ so as to annul the change.

- (i). - Concentration ✓ ~~or~~. Any 2 only
- Temperature ✓ ~~If 3 given by sheet~~
- Addition of an inert gas. ~~Add/Subtract~~ ~~=~~
- Pressure for gaseous systems / reactants / products.

(ii) Concentration:

Considering the reaction below at equilibrium



When more reactant A is added to the equilibrium mixture, B reacts with the added A to form C and D and therefore reducing the concentration of the added A due to Le Chatelier's principle.

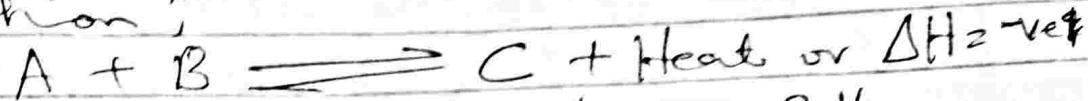
This keeps the ~~eq~~ value of the ~~constant~~ ~~unaltered~~ but the position of equilibrium shifts from the left to the right.

or If at equilibrium, B is removed/withdrawn, its concentration reduces. But then, C and D react together to produce ~~A + B~~ A and B, replacing/producing more B due to Le Chatelier's principle. This keeps the value of equilibrium constant unaltered and the position of equilibrium shifts from right to left.

Temperature:

This depends on whether the reaction is endothermic or exothermic.

Considering the ~~next~~ equilibrium reaction;



If the temperature of the equilibrium mixture is increased, C will dissociate/decompose to form A and B since increase in temperature favours the backward endothermic reaction.

This shifts the positions of equilibrium from right to left O2L.

The value of the equilibrium constant decreases.

or Decrease in temperature favours the forward exothermic reaction therefore more A and B react to produce C which shifts position of equilibrium from left to right and the equilibrium constant value increases.

Pressure

This depends on the number of molecules (whether of both reactants and products) at equilibrium.

Consider the general reaction equation at equilibrium;



1 mole 1 mole + 1 mole.

1 volume ~~2~~ 2 volumes,

Increase in pressure favours the backward reaction which proceeds with a decrease in total volume and the shifts position of equilibrium from right to left O2L.

Equilibrium constant value does not change ~~since~~ due to Le Chatelier's principle.

$$K_c = \frac{[CO]^4}{[Ni(CO)_4]}$$

Reject:

* wrong concentration
sign.

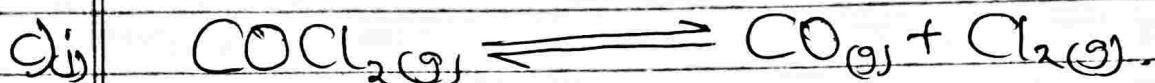
Unit is mol³ dm⁻⁹.

03.

$$K_p = \frac{(P_{CO})^4}{P_{Ni(CO)_4}}$$

Unit is atm³.

(ii) Position of equilibrium does not change.
Since it provides a reaction path of lower activation energy.



Let the equilibrium mole of Cl₂ be x.

	COCl ₂	CO	Cl ₂
Initial moles	1	0	0
Change	-x	+x	+x
Equilibrium moles	1-x	x	x.
	= 1 - 0.25392	0.25392	0.25392.
Equilibrium Concentration (mol dm ⁻³)	= <u>0.74608</u> 2	<u>0.25392</u> 2	<u>0.25392</u> 2
	= 0.37304	0.12696	0.12696

Total moles at eqm = 1-x+x+x = 1+x.

At equilibrium,

$$\frac{x}{1+x} \times 100\% = 20.25\%$$

$$100x = 20.25 + 20.25x$$

$$100x - 20.25x = 20.25$$

$$79.75x = 20.25$$

$$x = 0.25392$$

$$K_c = \frac{[CO][Cl_2]}{[COCl_2]}$$

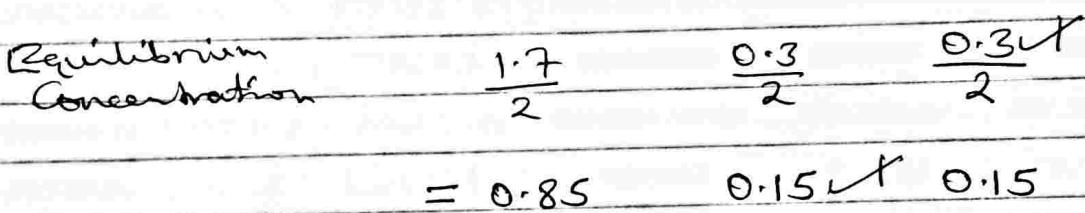
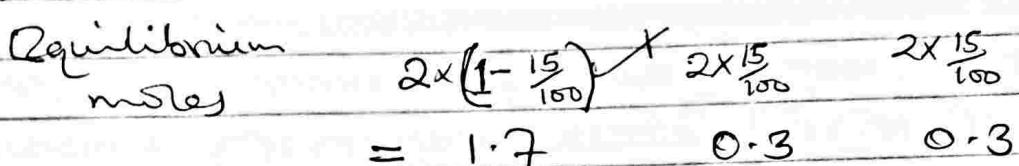
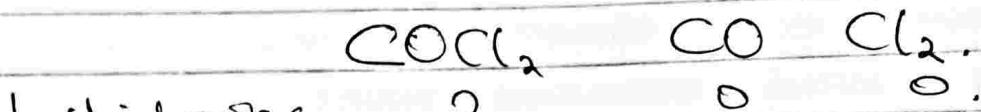
$$K_c = \frac{(0.12696)^2}{0.37804} \checkmark$$

~~03~~

- *~~03~~
- * Don't award if:
- * No unit is written
- * No K_c expression

$$\underline{K_c = 4.321 \times 10^{-2} \text{ mol dm}^{-3}}$$

Q(ii)



$$K_c = \frac{(0.15)^2}{0.85} \checkmark$$

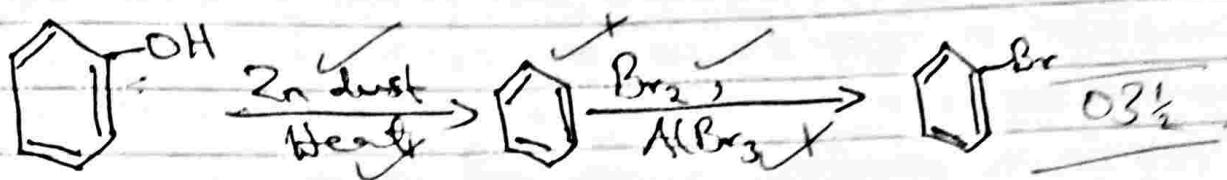
~~03~~

$$\underline{\underline{= 2.647 \times 10^{-2} \text{ mol dm}^{-3}}}$$

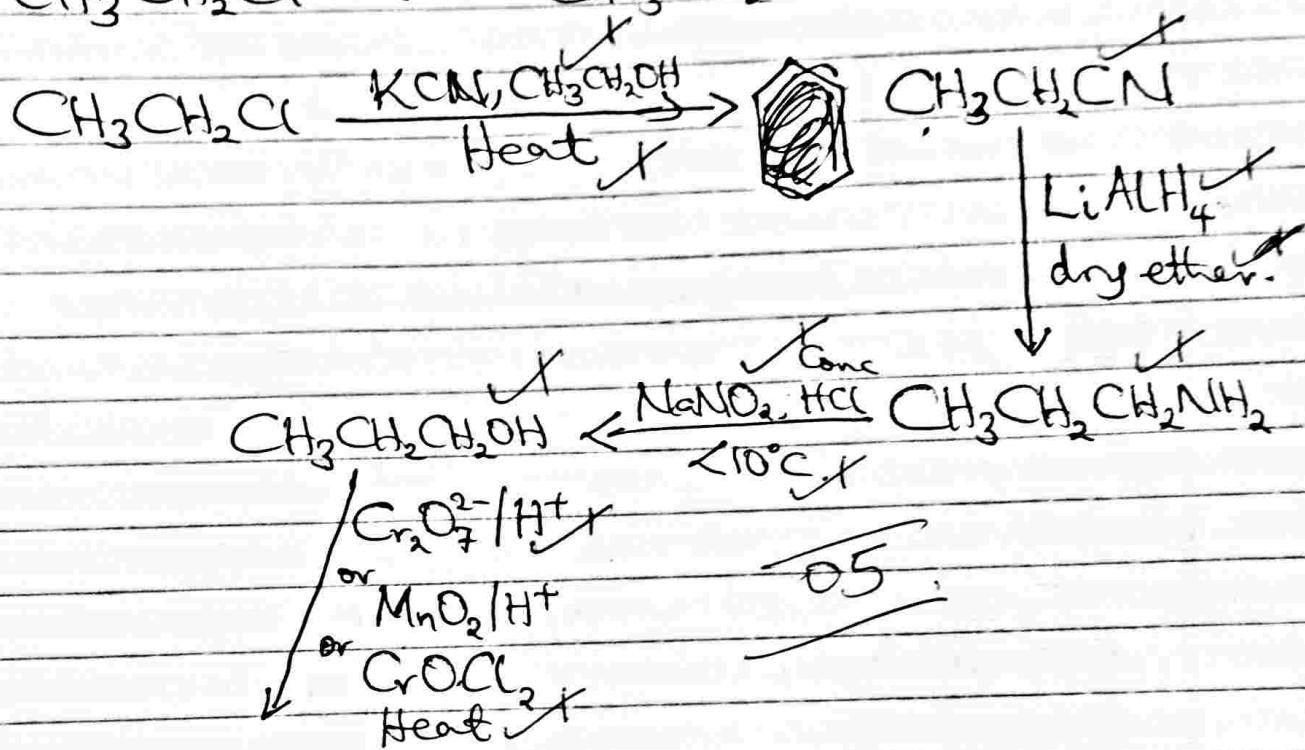
(iii) The forward reaction is exothermic.

Because increase in temperature from 25°C to 75°C , decrease the equilibrium constant from 4.321×10^{-2} to 2.647×10^{-2} ~~02~~, respectively which means that, increase in temperature makes few of COCl_2 to dissociate therefore producing few CO and Cl_2 and this shifts equilibrium position from right to left which decreases the K_c . 20

(a) Bromobenzene \rightarrow from Phenol.

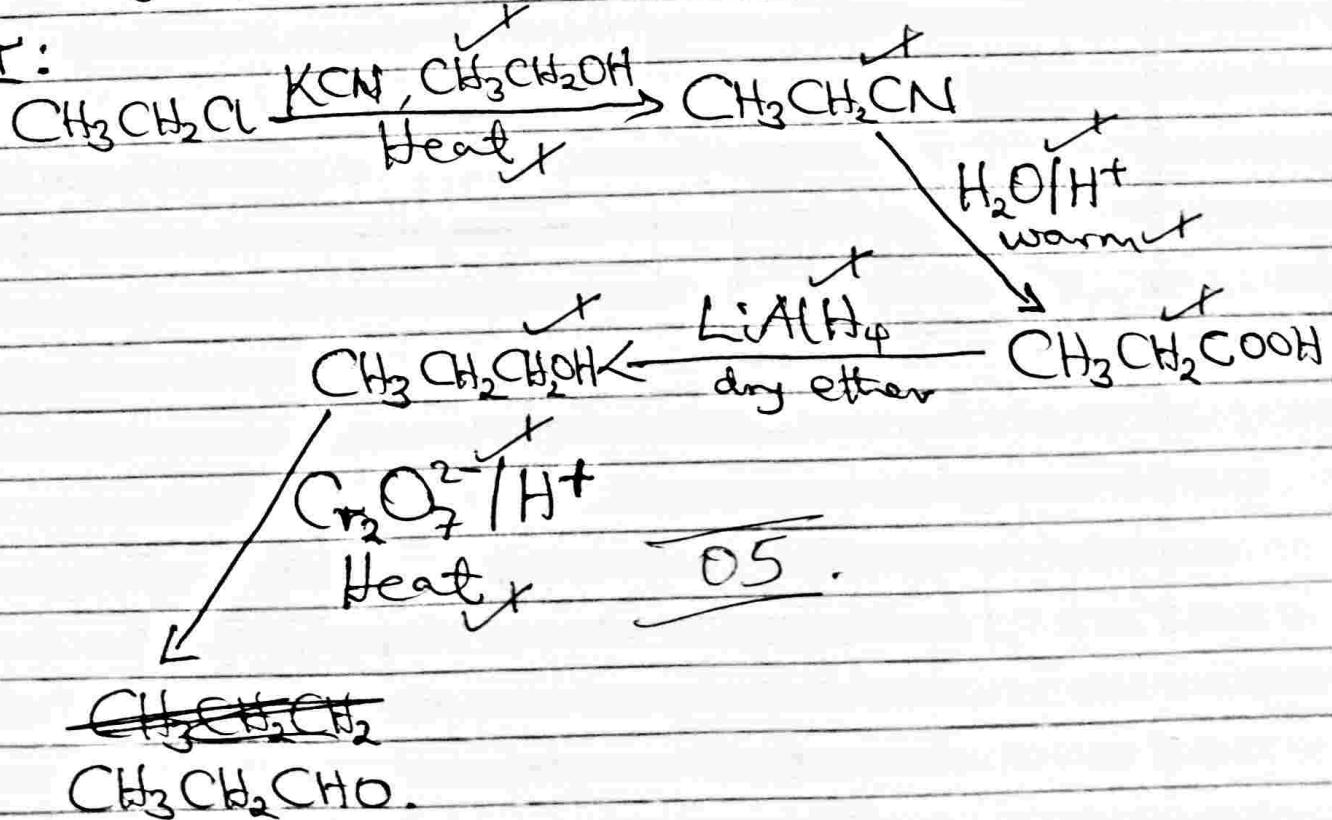


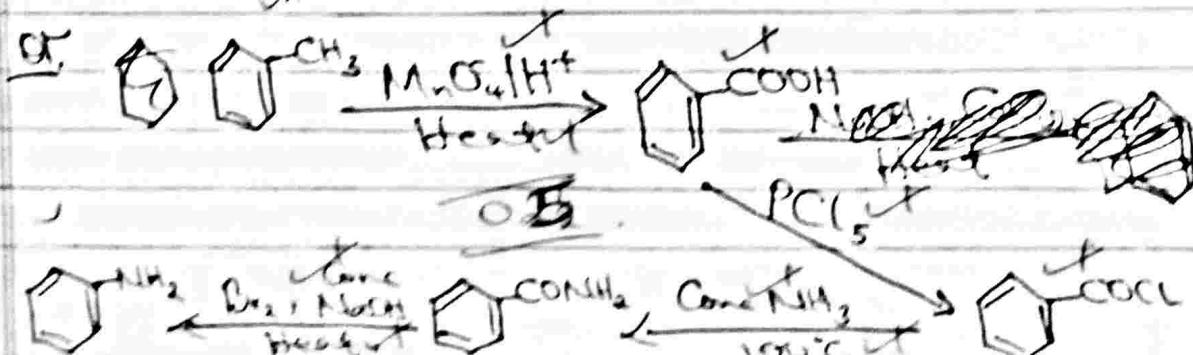
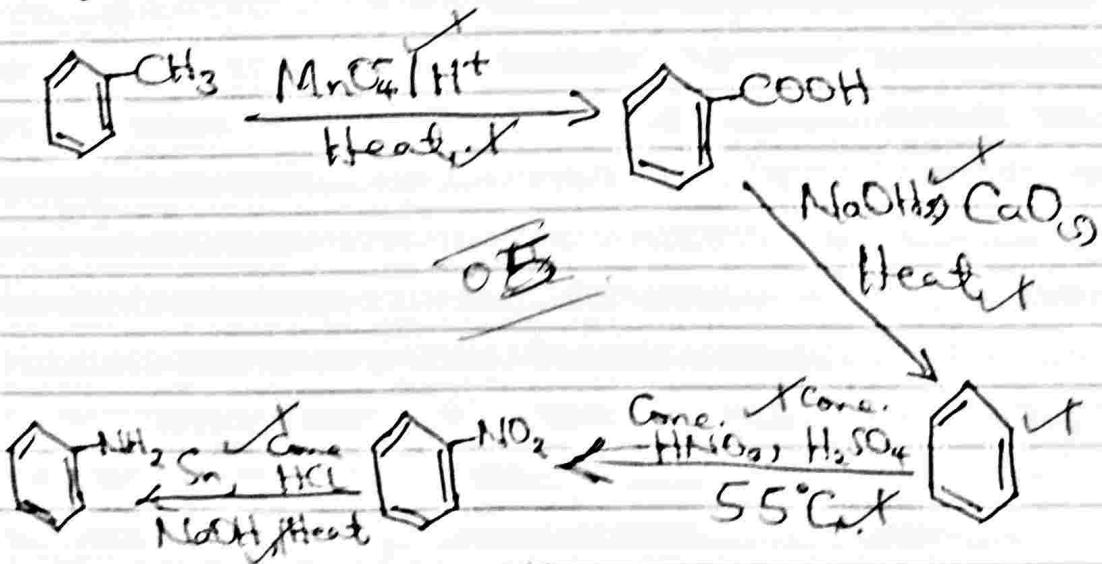
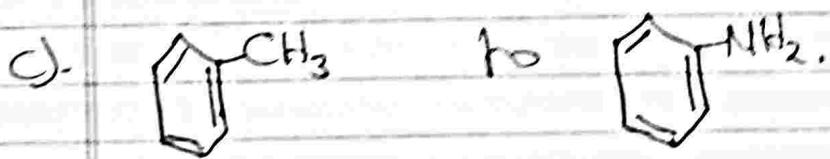
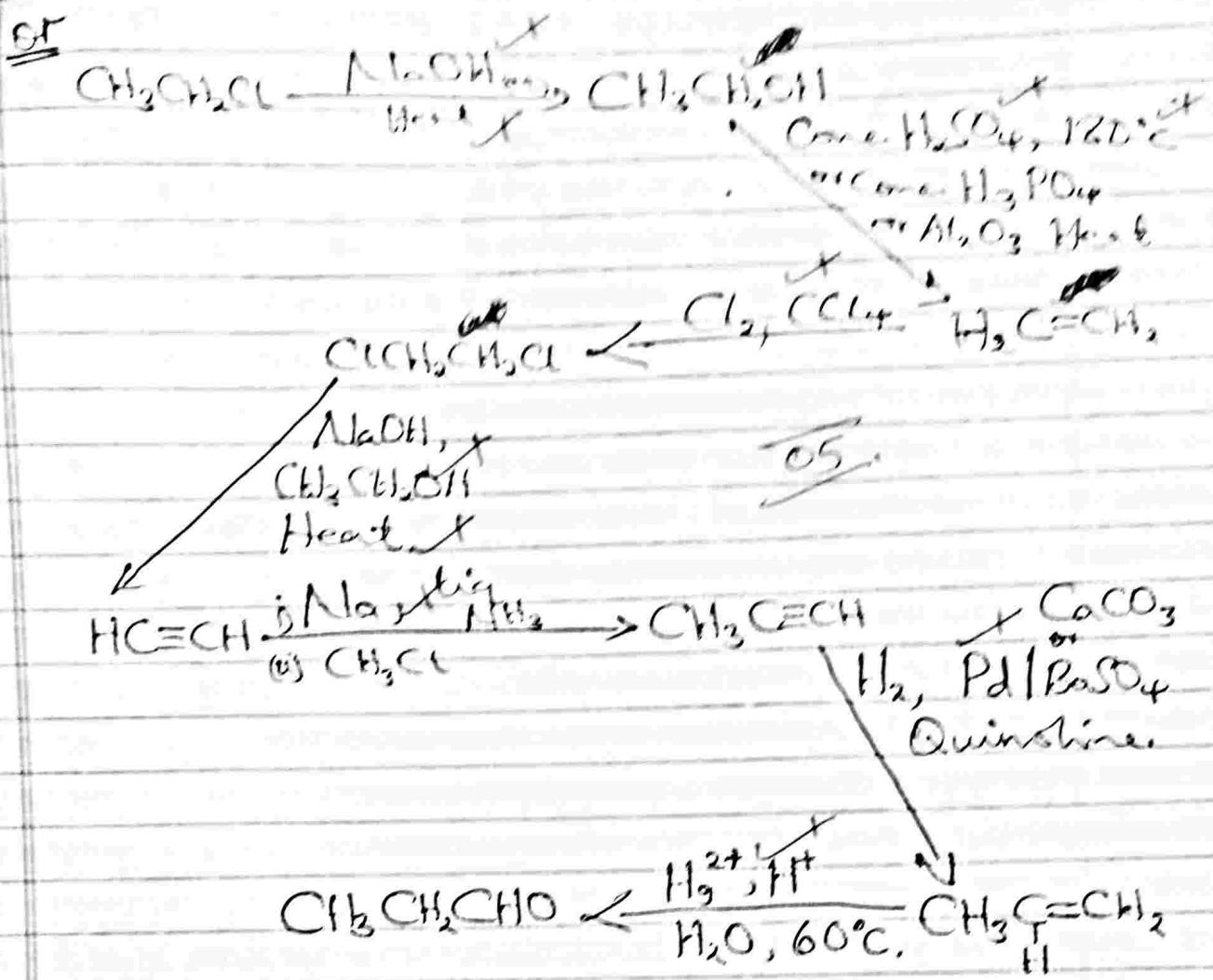
b). $\text{CH}_3\text{CH}_2\text{Cl} \rightarrow \text{CH}_3\text{CH}_2\text{CHO}$.

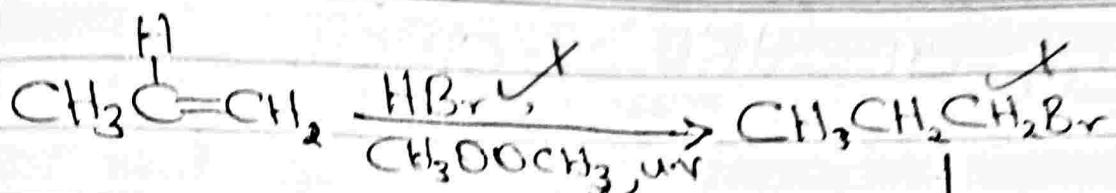


$\text{CH}_3\text{CH}_2\text{CHO}$.

Or:

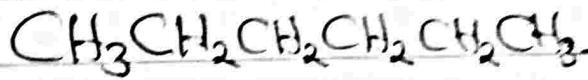




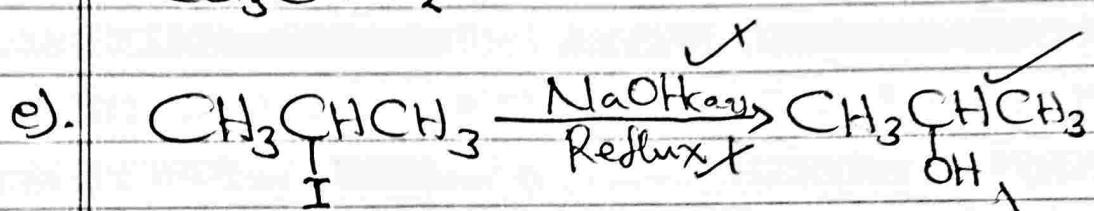


$\cancel{\text{O}_2 \frac{1}{2}}$

\downarrow
 $\text{Na}_{(\text{s})}$
 dry ether.

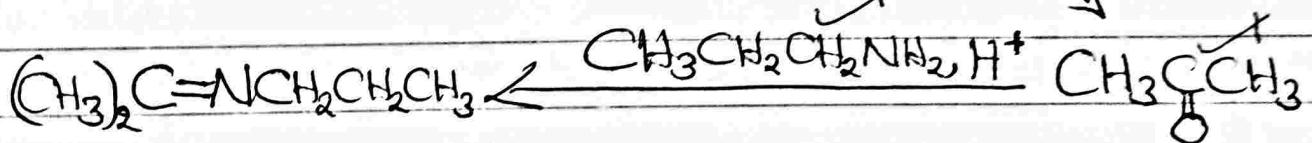


~~OR: II~~
 ~~$\text{CH}_3\overset{\text{H}}{\underset{\text{I}}{\text{CH}_2}}\text{CH}_2\text{H}_2$~~



$\cancel{\text{O}_2 \frac{1}{2}}$

\downarrow
 $\text{MnO}_4^-/\text{H}^+$
 or $\text{Cr}_2\text{O}_7^{2-}/\text{H}^+$
 Heat \checkmark



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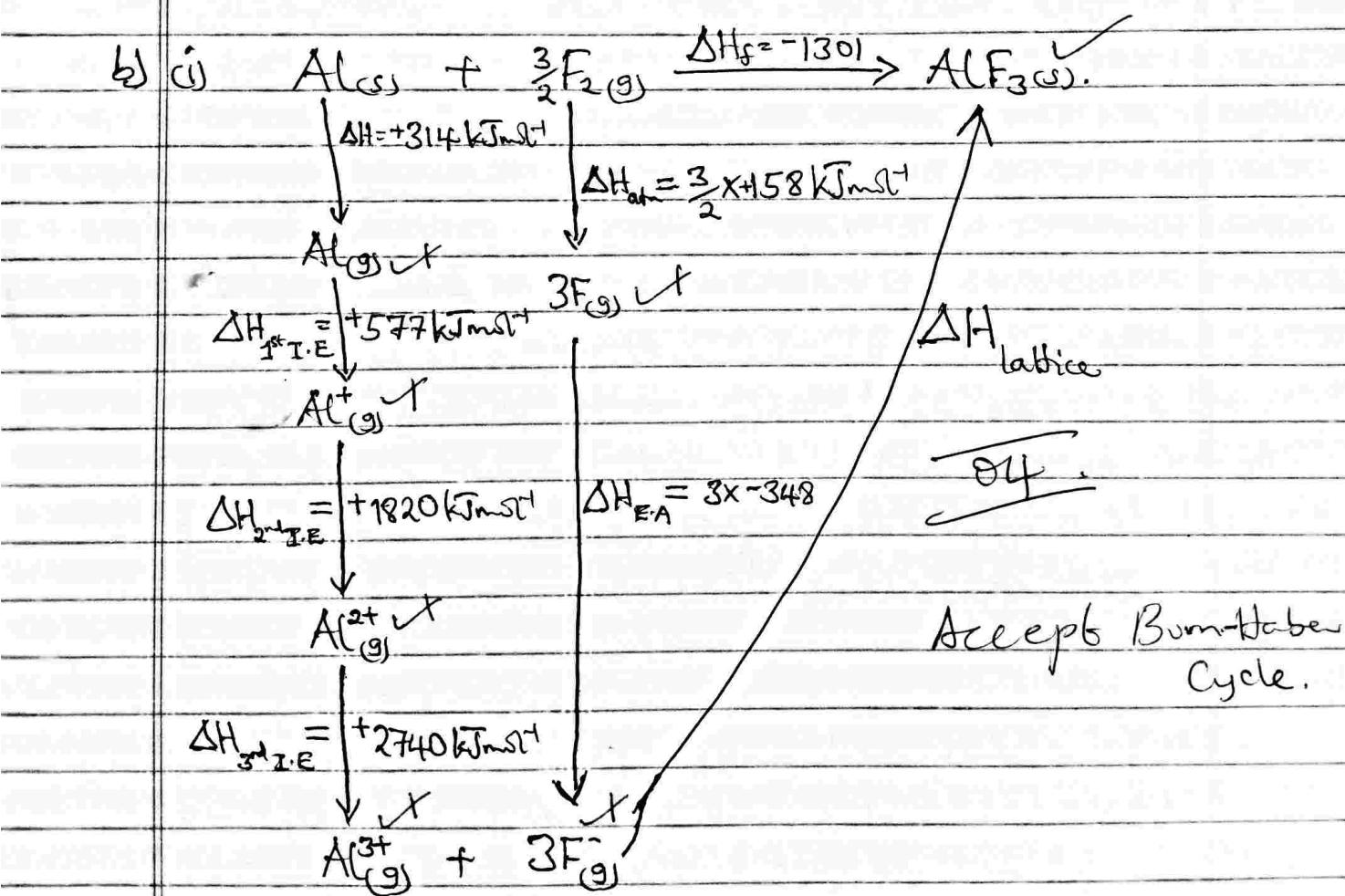
is
Lattice energy is the heat energy given out when one mole of an ionic crystal lattice is formed from its constituent gaseous ions.

Q.

or
Lattice energy is the heat energy absorbed when one mole of an ionic crystal lattice is broken down into its constituent gaseous ions.

Q.

(ii) Hydration energy is the heat energy given out when one mole of a gaseous ion is completely surrounded by water molecules to form an infinitely dilute solution.



To find the total $\Delta H_{\text{lattice}}$

$$-1301 = 314 + 577 + 1820 + 2740 + \left(\frac{3}{2} \times 158\right) + (3 \times -348) +$$

$$-1301 = 4644 + \Delta H_{\text{lattice}}$$

$\Delta H_{\text{lattice}}$

$$\Delta H_{\text{lattice}} = -5945 \text{ kJ mol}^{-1}. \quad \underline{\text{O2}}$$

\therefore Lattice energy of AlF_3 is $-5945 \text{ kJ mol}^{-1}$!

b) (ii)

Enthalpy of solution of AlF_3 = Lattice energy of AlF_3 + Hydration energy of AlF_3

$$= 5945 + (-4690 + 3 \times -364)$$

$$= +163 \text{ kJ mol}^{-1}$$

\therefore Enthalpy of solution of AlF_3 is $+163 \text{ kJ mol}^{-1}$.

Comment:

Aluminium fluoride is sparingly soluble in water since its enthalpy of solution is less positive.

Reject if $\Delta H_{\text{lattice}}$ is wrong
if $\Delta H_{\text{solution}}$ is wrong.

O.

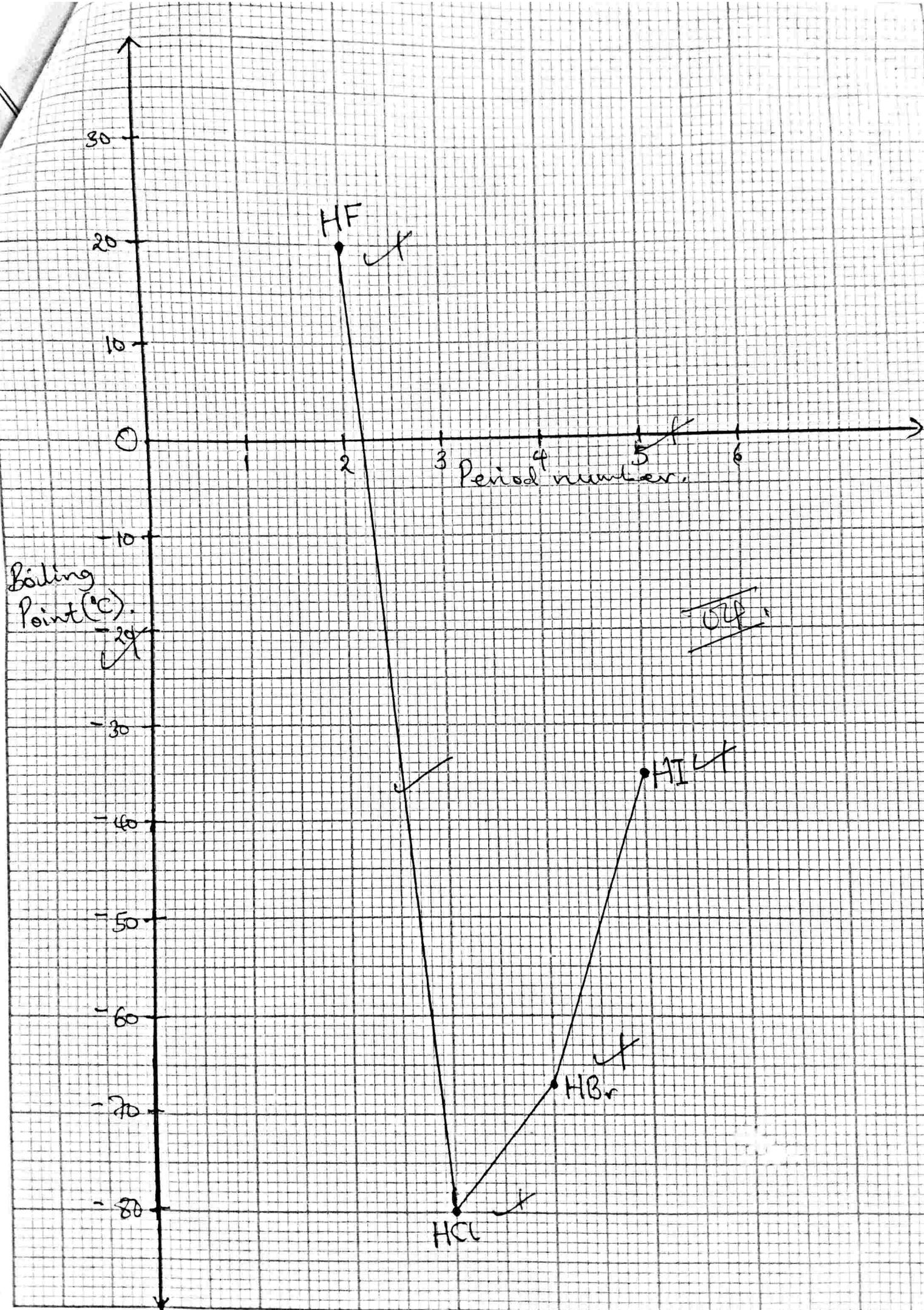
c). * ionic radius

The smaller the ionic radius of the ion, the ~~stronger~~ ~~to more~~ closer the opposite ions approach each other and the ~~strong~~ stronger the electrostatic force of attraction and hence the lattice energy value will be large. O2.

* ionic charge

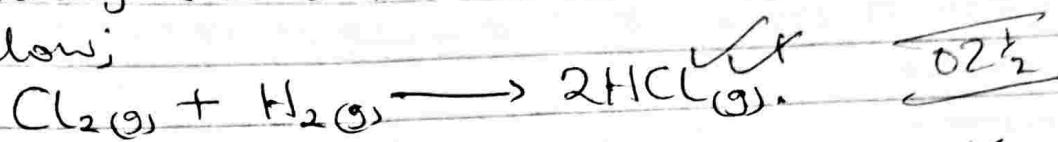
The larger/bigger the value of charge on the ion, the stronger the electrostatic forces of attraction and hence the bigger the value of lattice energy.

d). Lattice energy of AlCl_3 would be less than that of AlF_3 .



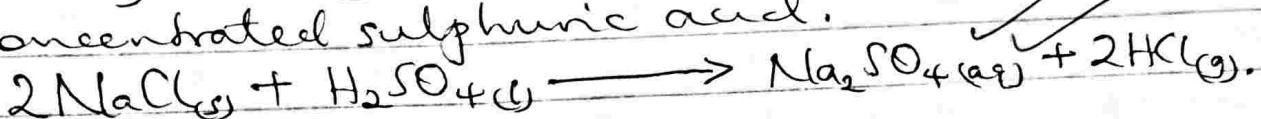
(ii) Hydrogen chloride

Hydrogen chloride is prepared by reacting/exploding chlorine with hydrogen gas ~~in~~ the presence of sunlight or u.v or on heating to form HCl as below;



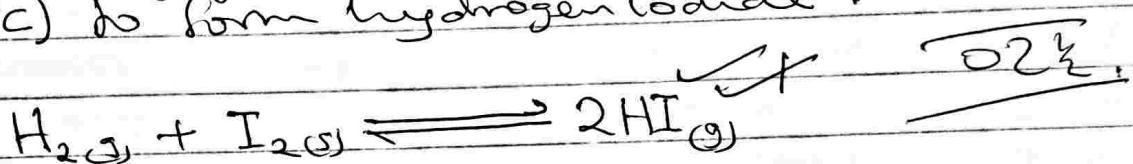
or

By heating Sodium chloride ~~solds~~ with concentrated sulphuric acid.



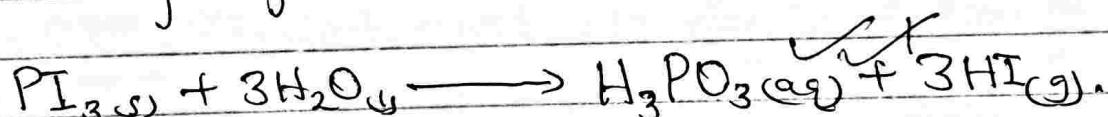
(iii) Hydrogen iodide

By reacting iodine with hydrogen in the presence of platinum catalyst at 400°C (or 300°C) to form hydrogen iodide.



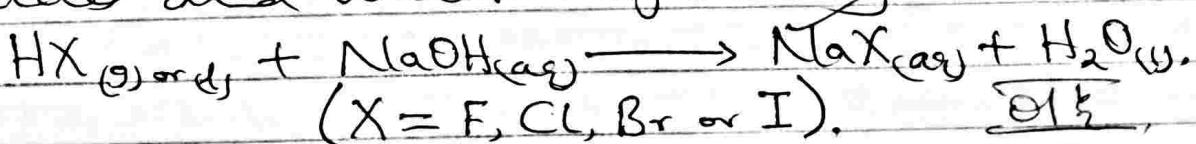
or

Through hydrolysis of phosphorous triiodide to form phosphorous acid and hydrogen iodide



(i) With NaOH.

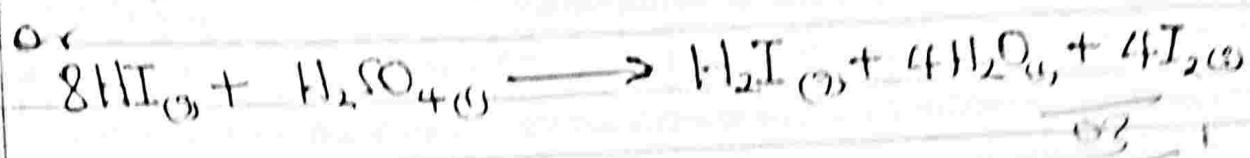
All the hydrides react with dilute sodium hydroxide to form ~~these~~ their respective halides and water respectively as below)



(ii) With sulphuric acid.

HF and HCl don't react with concentrated sulphuric acid because they all oxidizing agents

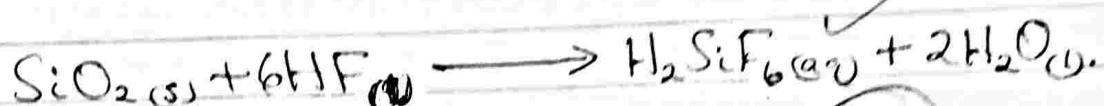
However HBr and HI are oxidized by hot concentrated sulphuric acid to Bromine and Iodine respectively and the sulphuric acid reduced to sulphur dioxide and water.



OR 1

(iii) With Silicon dioxide:

Silicon dioxide reacts with hydrogen fluoride (or hydrofluoric acid) to form hexafluorosilicic acid and water.



(20%)

Ques Flotation:

In this method, the ore is finely powdered/pulverised, mixed with water, to which one or more chemical frothing agents e.g. palm oil, eucalyptus oil, etc are added and then air is blown through the mixture to form a froth. The oil wets the ore while the water wets the gangue/earthly materials, and sinks to the bottom.

The sulphide ore particles/froth, however rise to the surface in the froth where they can be skinned off the surface and an acid is added to break up the froth.

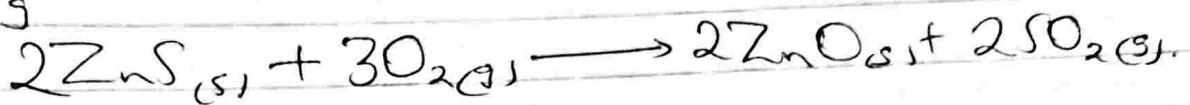
The concentrated ore is filtered and dried.

(ii) Roasting.

In this process, the concentrated ore is heated in a controlled amount of air to convert the ore into its oxide and is accompanied by Calcination which is the

heating of the ore to bring about decomposition with elimination of O_3 volatile products e.g. SO_2 , CO_2 , H_2O etc.

e.g.

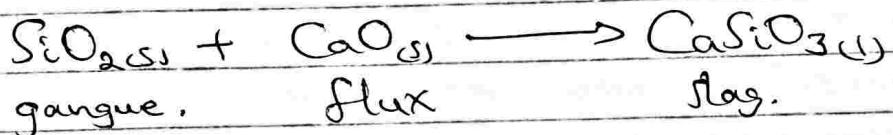
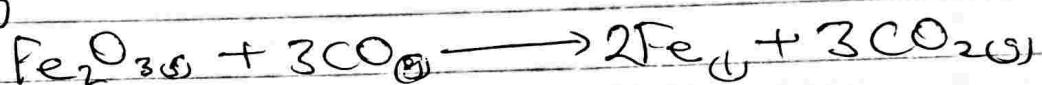


(iii) Smelting:

This involves the reduction of the ore to the molten metal at a high temperature.

Substances called fluxes are added to combine with the gangue to form liquid slag which floats on the surface of the molten metal layer.

e.g.

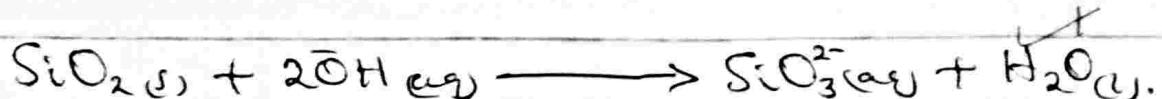
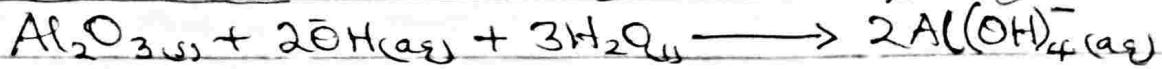


b). Purification / Concentration of Aluminium ore.

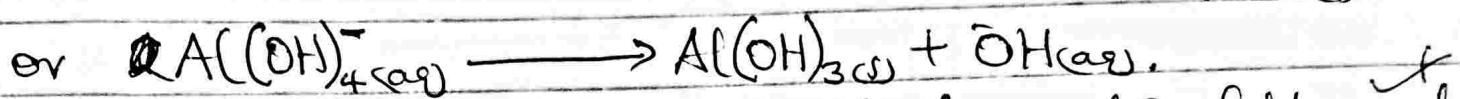
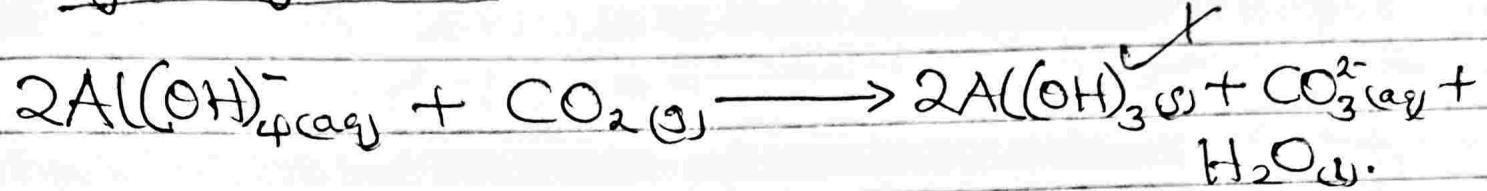
Aluminium is extracted from bauxite ore, $Al_2O_3 \cdot 2H_2O$.

The bauxite is first heated at low temperature to convert iron to iron(III).

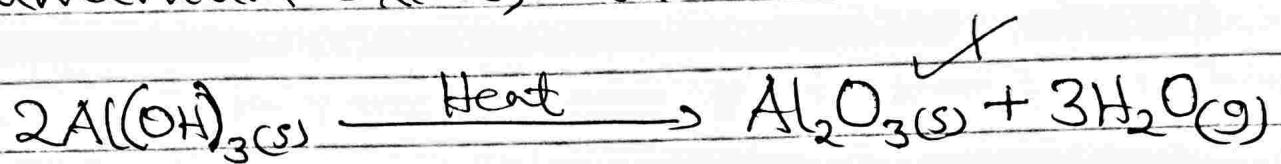
The powdered product is heated with excess concentrated sodium hydroxide to free the ore from Silica, iron(III) oxide and titanium(IV) oxide. The amphoteric aluminium oxide and acidic silicon dioxide dissolve in the alkali but basic iron(III) oxide and titanium(IV) oxide don't dissolve and then filtered off.



The mixture is seeded using pure aluminium hydroxide or carbon dioxide gas to precipitate aluminium hydroxide.



The aluminium hydroxide formed is filtered off and heated strongly to form anhydrous aluminium oxide, alumina.



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