

TANZANIA HEADS OF ISLAMIC SCHOOL COUNCIL

FORM SIX INTER ISLAMIC MOCK EXAMINATION 2025

CHEMISTRY-2 MARKING SCHEME

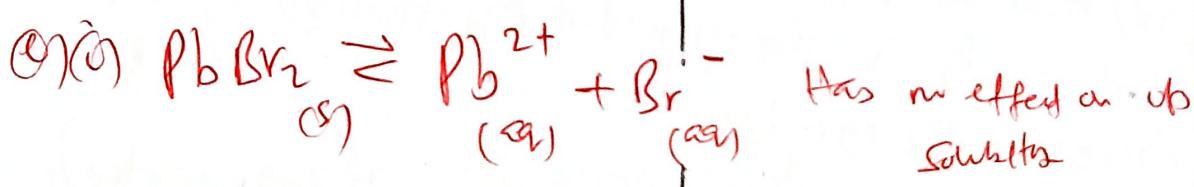
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wazaelimu.com

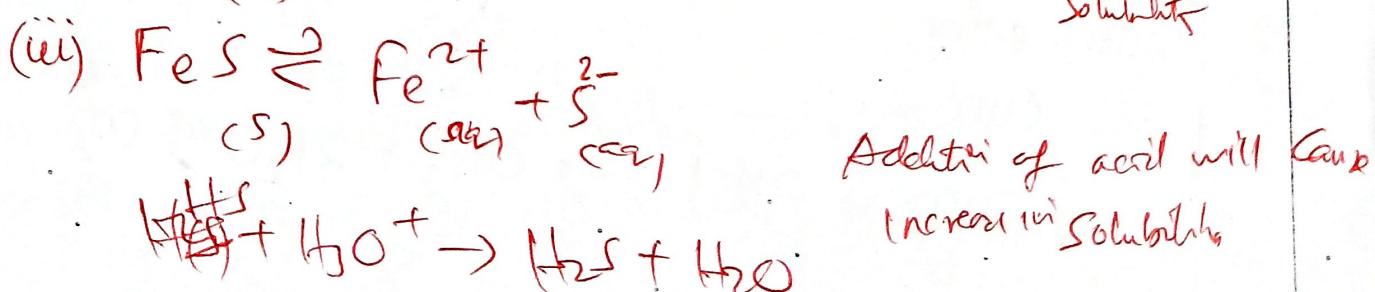
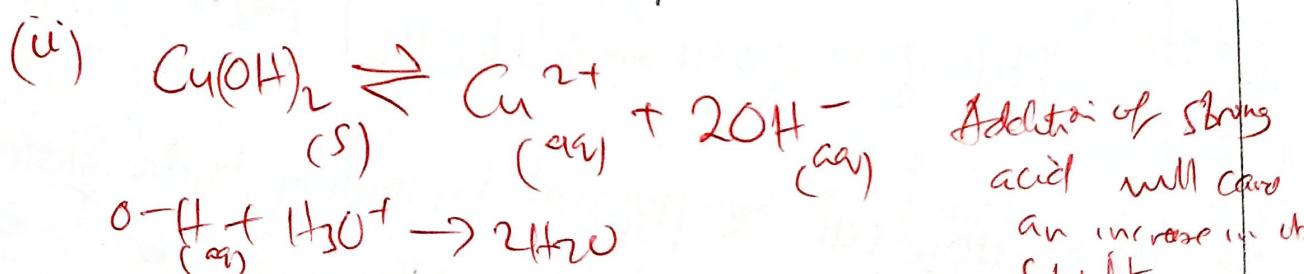
$$5(a)(i) \quad P_H = 4.4$$

$$(ii) \quad P_H = 4.26$$

$$5(b) \quad K_{SP} = 1.4 \times 10^{-3} \text{ M}^{-3}$$



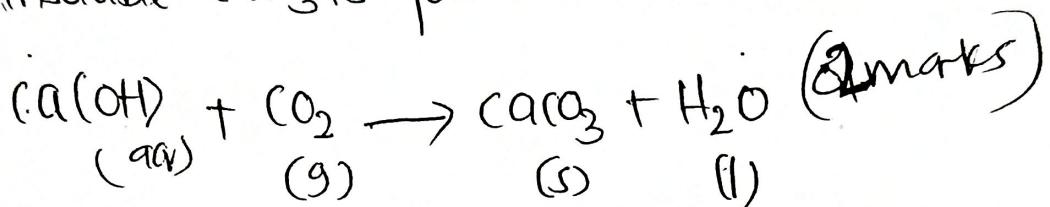
(i) (ii) (iii) 6
 (iv) (v) (vi) 1
 (vii) (viii) (ix)
 (x)



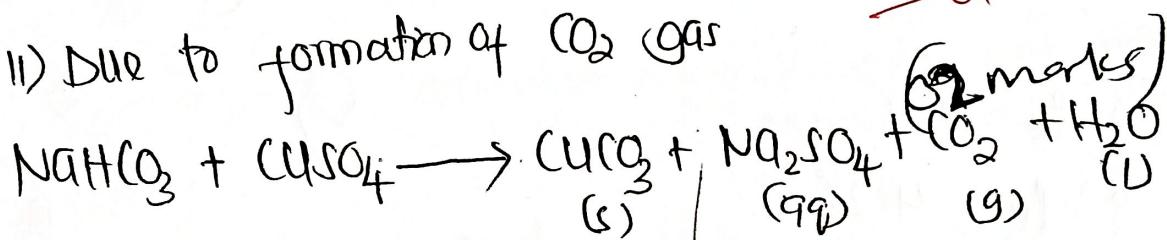
1 (a) i) small size of Fe and Al have higher polarising power - hence are decomposed as they are formed (2 marks)

~~Redox reaction~~

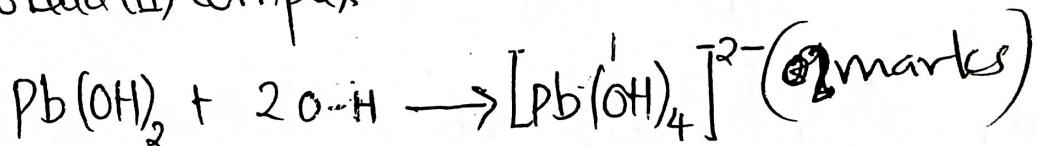
ii) Insoluble CaCO_3 is formed and turns lime water milky (1)



iii) Due to formation of CO_2 gas

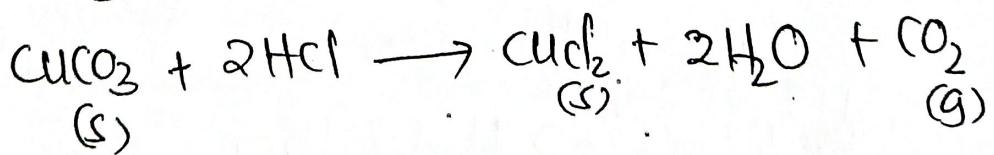


iv) Addition of excess NaOH results in excess O-H^- ions - which leads to the formation of colourless soluble tetra hydroxido Lead (II) complex (1)

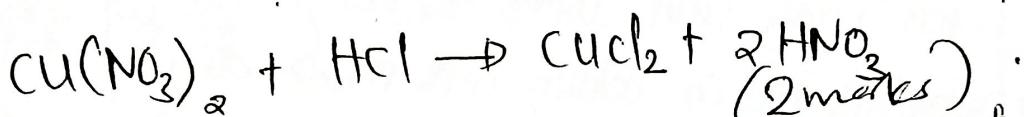
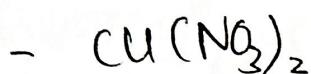
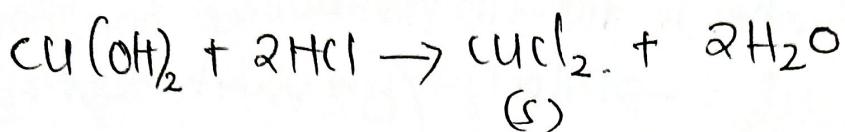
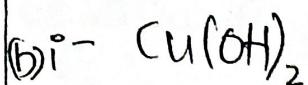


b) CuCl₂ can be prepared by reacting hydrochloric acid with either

- CuCO_3



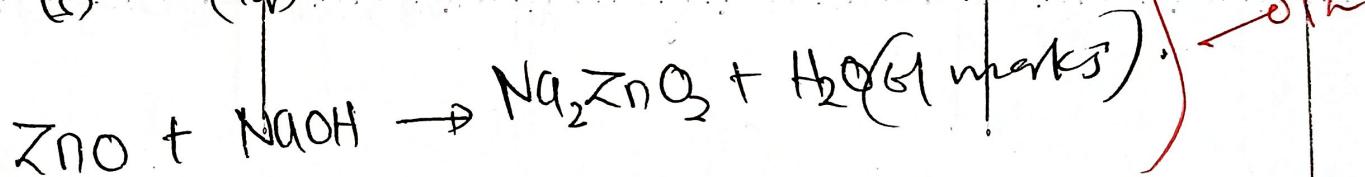
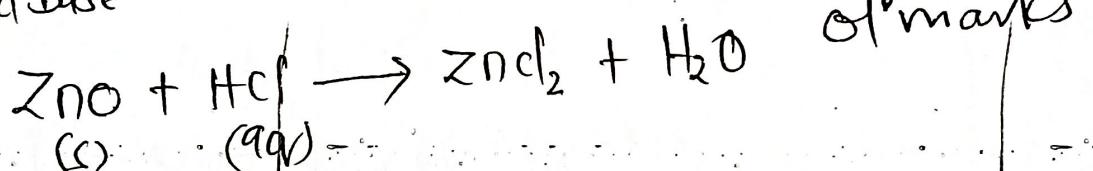
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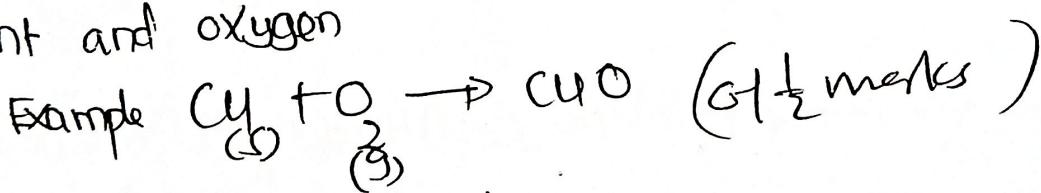
at least 2 part, 1 mark each
with both acid -

ii) Zinc oxide is amphoteric oxide it reacts with both acid -
(01 marks)

and base



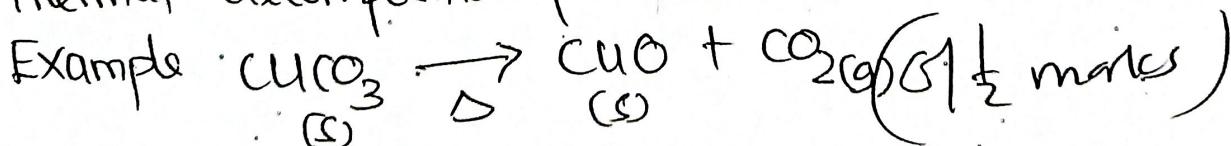
III) - Direct method of preparing metal oxides
By direct reaction or oxygen combination between metallic element and oxygen



even water
is important
(01h)

- Indirect method

Thermal decomposition of metallic carbonate.

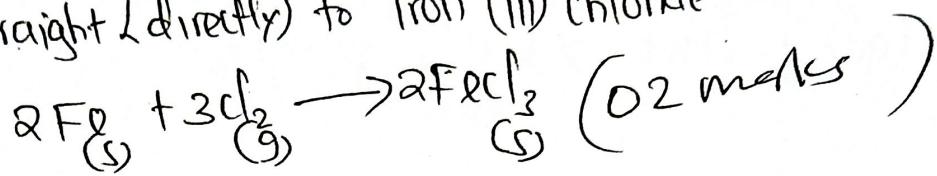


even if
important
(01h)

(02)

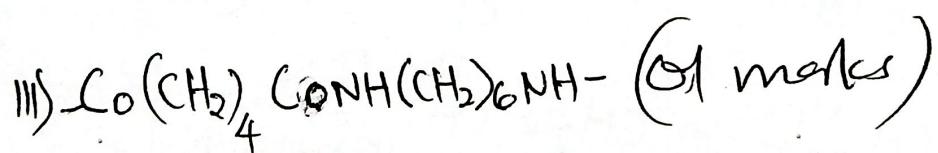
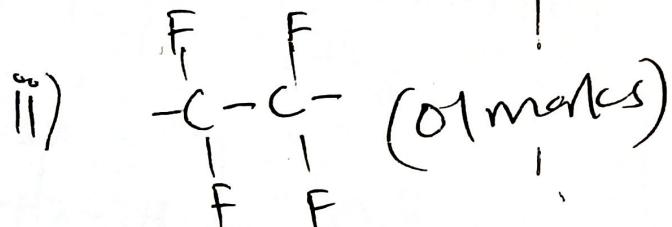
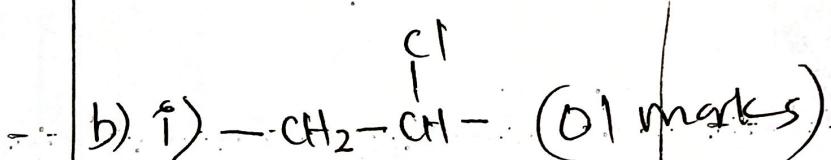
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i) chlorine is a strong oxidizing agent hence it will oxidise iron straight (directly) to Iron (III) chloride



ii) Cl^- ion may react with Fe^{2+} as a titration product to form FeCl_2 which is red in colour, this makes difficult to identify changes in MnO_4^{4-} colour. (0.2 marks)

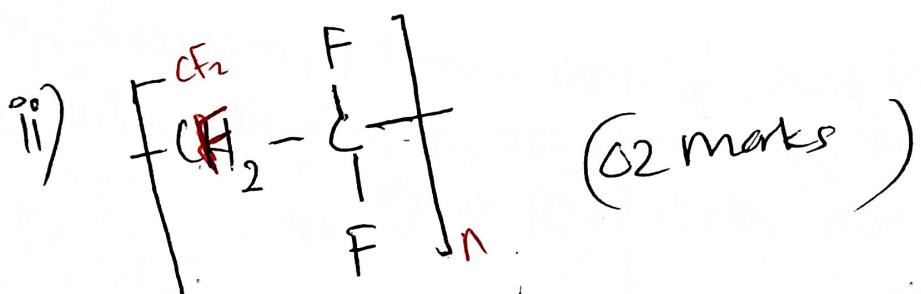
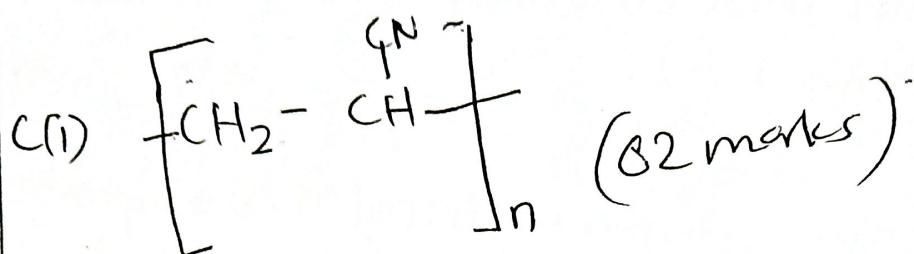
- 2 a) i) Thermoplastic polymer is the polymer which become soft on heating and become hard on cooling Example nylon 6,6 polyethylene (01 marks)
- defn - 0.5
example - 0.5
- ii) Thermosetting polymers, polymers which hard on heating and can be soften by cooling Example Bakelite (01 marks)
- defn - 0.5
example - 0.5
- iii) Condensation polymers, polymers formed by combination of monomers with elimination of simple molecules such as H₂O or CH₃OH Example polyester (01 marks)



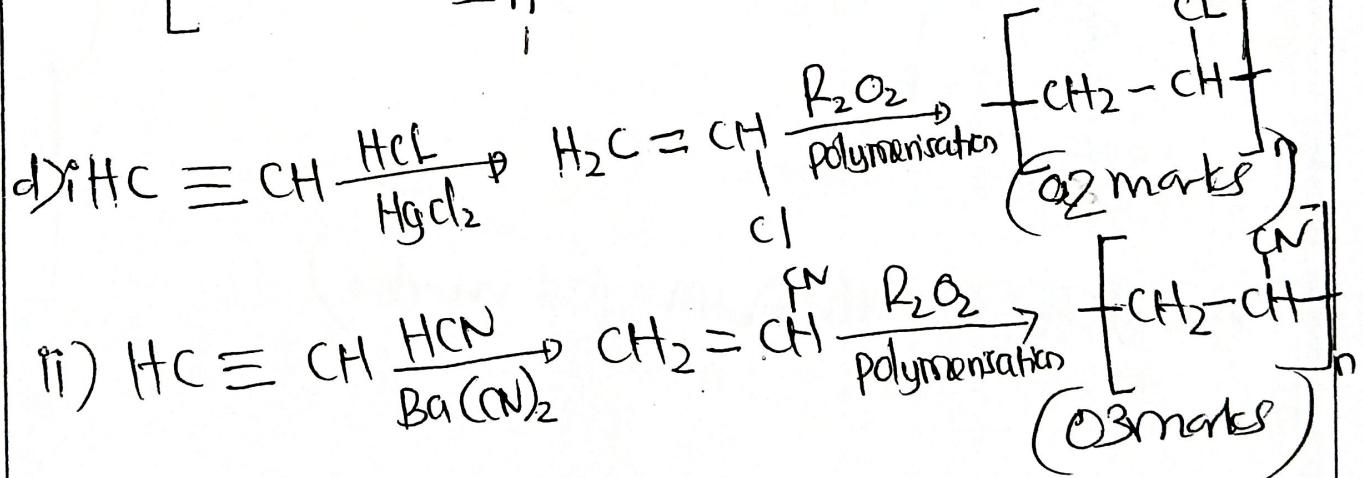
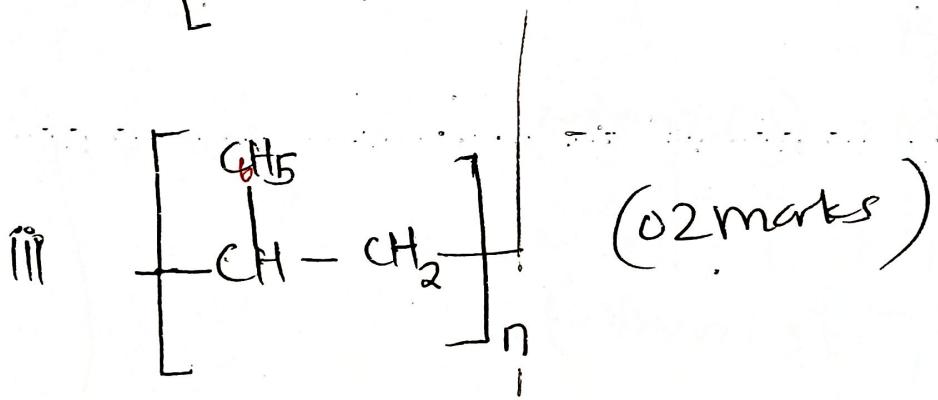
defn - 0.5
example - 0.5

03

2 (c)

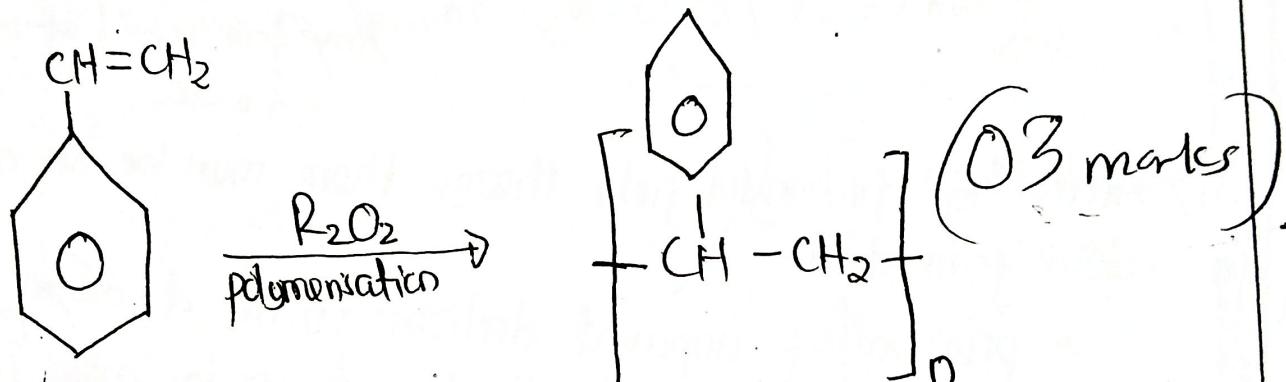
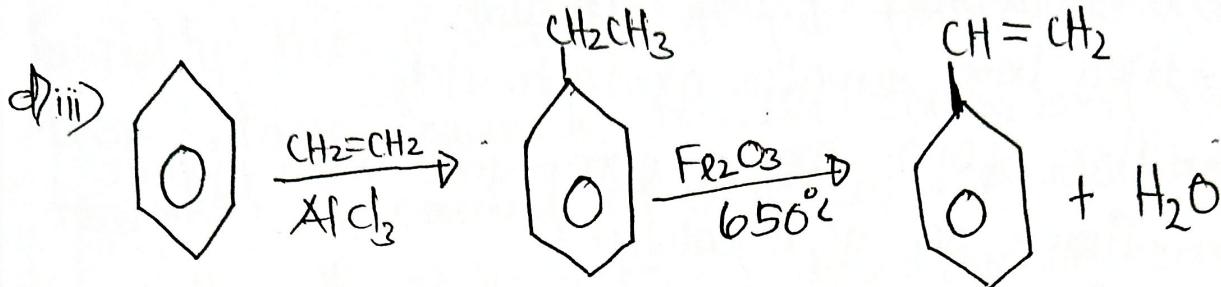


(06)



(05)

2



3

- (a) i
- They form coloured compounds
 - They have variable oxidation state
 - They form complex compounds with ligands
 - They act as a catalyst
 - They have magnetic property
- Any four point (If marks)
1 each.

ii) According to crystal field theory there must be two conditions for colour formation

- presence of unpaired electrons in the d-orbital
- presence of negatively charged species called Ligands

The process starts when the ligand approaches d-orbital containing unpaired electrons which exert repulsive effect causing the splitting of d-orbital into two parts which are double degenerate and treble degenerate (01 marks)

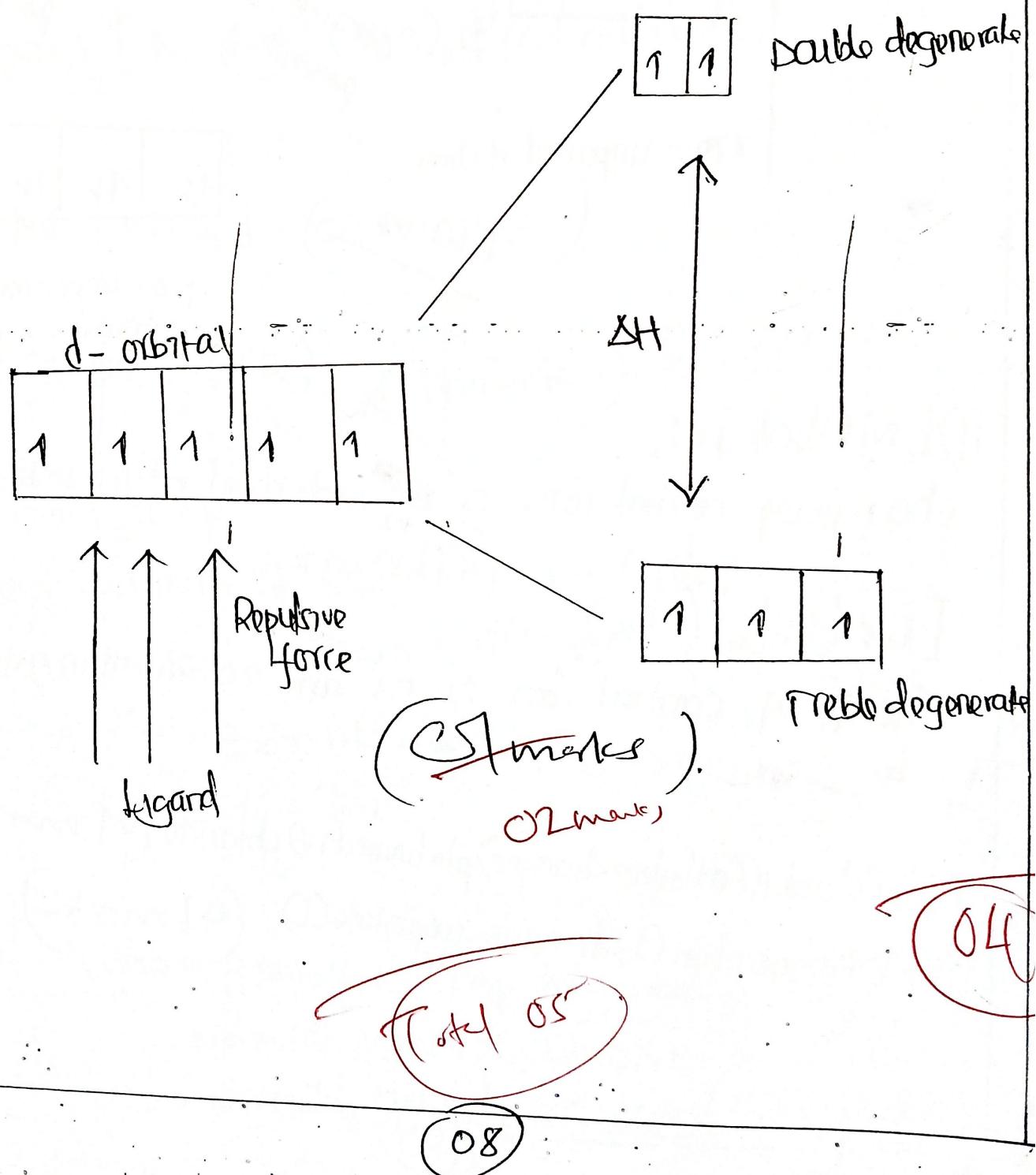
Double degenerate has raised energy hence found on upper part while treble degenerate has lower energy and found on the lower part. The gap separation will depend on the nature of ligand. For weak field ligand the gap separation between double and treble degenerate is very small, thus normal radiant energy can excite electron from treble to double degenerate making it to be unstable. To maintain (01 marks)

~~07~~ explain

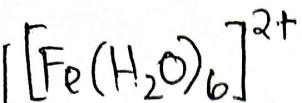
~~03~~ explain

3(a)

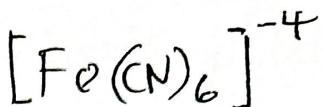
Instability the electron has to fall from higher energy level (double degenerate) to lower energy level (treble degenerate) by emitting radiant energy whose wavelength are within the visible part of hydrogen spectrum hence can be visible to human eyes. (01 mark)



3(b) i)



1	1
eg	



eg	

(0 1/2 mark)

potential order

1	1	1
t _{2g}		

(0 1/2 mark)

drawn by
Preeti (0 0 1/2)

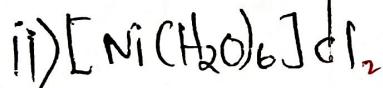
drawn by
Preeti (0 0 1/2)

Four unpaired electrons

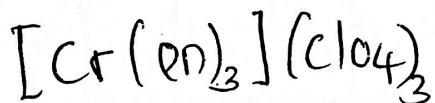
Total 0 2

1	1	1
t _{2g}		

No unpaired electrons

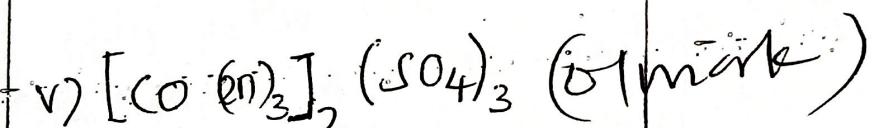
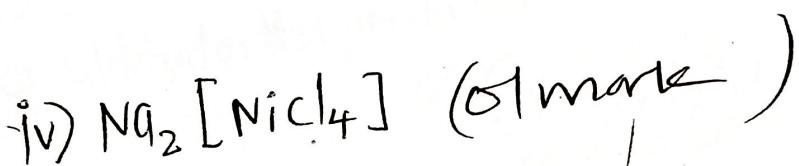
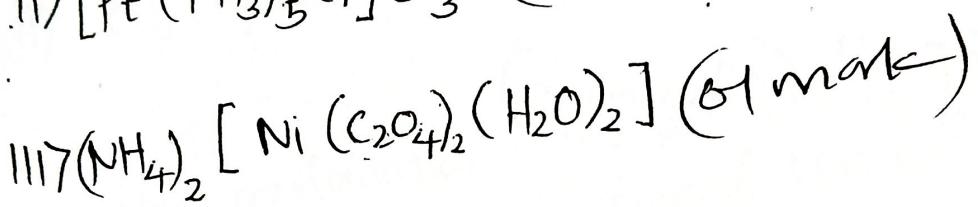
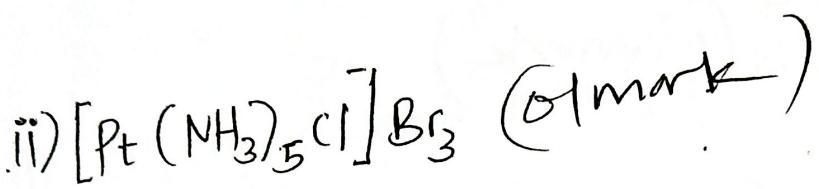
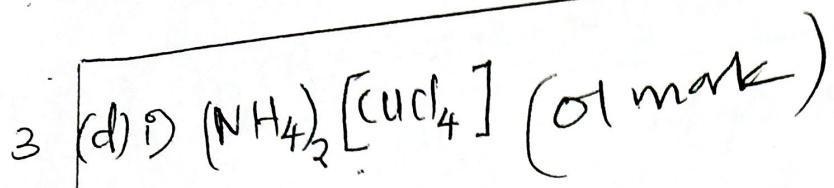


charge of central ion is +2 and coordination number is 6
(0 1 mark)



charge of central ion is +3 and coordination number is 6

- c) i) Diclorobis(ethylenediamine)platinum(IV)chloride (0 1 mark)
ii) Diamine silver(I) di(cyanoargentate)(I) (0 1 mark)



4 i) Data given

Empirical formula of compound M is $\text{C}_4\text{H}_8\text{O}$
from, Molecular mass = n (Empirical formula)

$$72 = n(\text{C}_4\text{H}_8\text{O})$$

$$\frac{72}{72} = \frac{72n}{72}$$

$$n = 1 \quad (01 \text{ mark})$$

From molecular formula = n (Empirical formula)

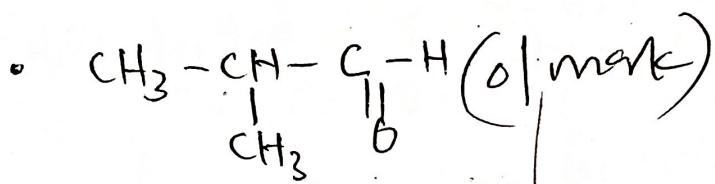
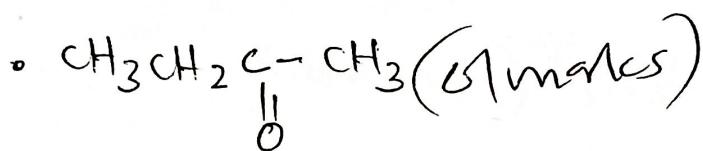
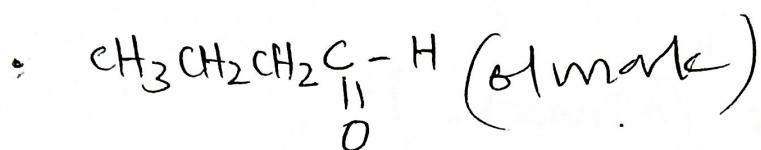
$$\text{Molecular formula} = (\text{C}_4\text{H}_8\text{O}) \times 1$$

$$\text{Molecular formula} = \text{C}_4\text{H}_8\text{O} \quad (01 \text{ marks})$$

(10)

4

(a)(ii) possible structures of M



b(i) Test A - Test for Alcohol (01 mark)

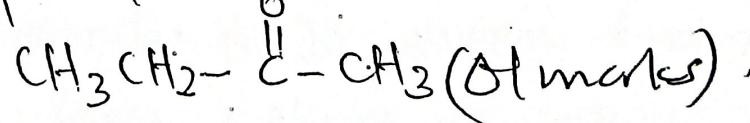
Test B - Test for unsaturated hydrocarbon / carbonyl (triple bond) (01 mark)

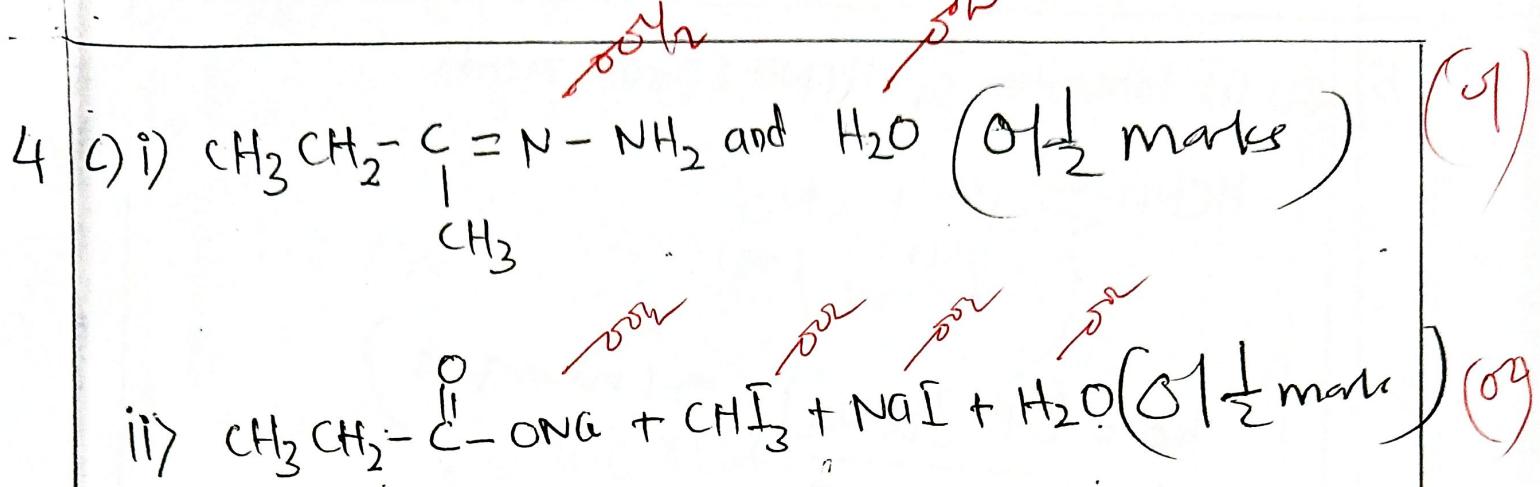
Test C - Test for aldehyde and ketone (01 marks)

Test D - Test for aldehyde (01 marks)

Test E - Test for ketone, aldehyde or alcohol with terminal methyl group (01 marks)

ii) structure of liquid M is

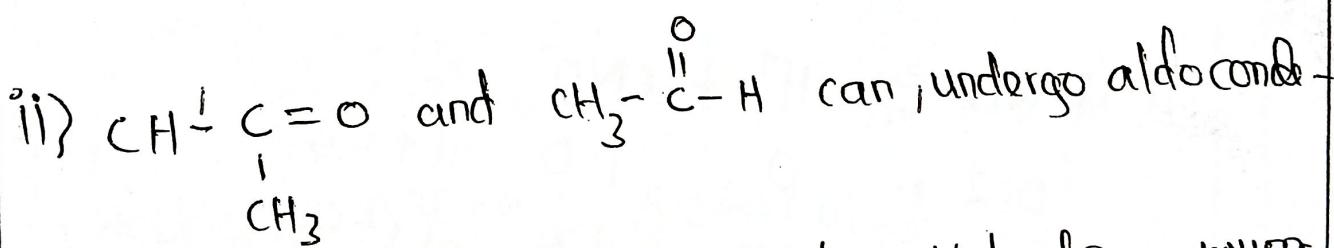




c) i) Aldo condensation is the combination between molecules of aldehydes themselves with minimal loss of water molecules

OR

Aldo is the chemical reaction between two aldehydes with α -hydrogen in alkaline medium to form large aldehyde-molecule with hydroxyl group at β -carbon. (03 marks) (02)

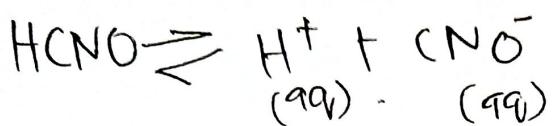


nsation due to the presence of replaceable hydrogen WHERE AS $(\text{CH}_3)_2-\text{C}-\text{CHO}$ and $(\text{CH}_3)_3-\text{CHO}$ can not undergo aldo condensation due to absence of replaceable hydrogen at α -carbon in all two groups

(03 marks) (01)

5

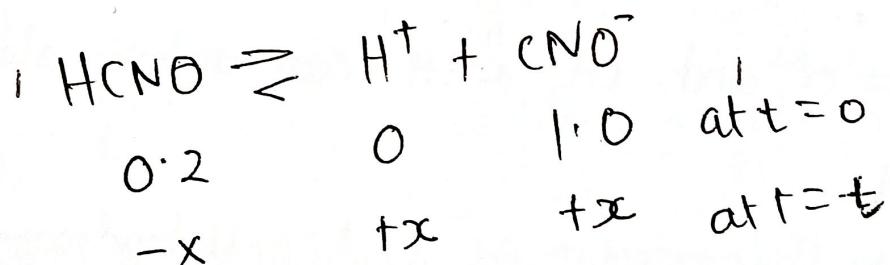
(a) (i) Ionization of HCNO (cyanic acid)



$$K_a = \frac{[\text{H}^+][\text{CNO}^-]}{[\text{HCNO}]} \quad (0 \text{ marks})$$

$$2.0 \times 10^{-4} = \frac{[\text{H}^+][\text{CNO}^-]}{[\text{HCNO}]}$$

$$[\text{HCNO}] = \frac{0.1 \text{ mol}}{0.50 \text{ litre}} = 0.2 \text{ M} (\text{mol dm}^{-3}) \quad (0 \text{ marks})$$



$$0.2-x \quad x \quad 1$$

$+x$ at equilibrium (0 mark)

But $1.0+x \approx 1.0 \text{ M}$ and $0.2-x \approx 0.2 \text{ M}$

$$5(i) \quad K_a = \frac{x \times 1.0}{0.2}$$

~~(i)~~ (i) 4
~~(ii)~~ (ii) 6

$$2.0 \times 10^{-4} = \frac{xM^2}{0.2} \quad (\textcircled{0} \textcircled{1} \text{ mark})$$

$$x = 4.0 \times 10^{-5} M$$

$$[H^+] = 4.0 \times 10^{-5} M$$

$$pH = -\log [H^+]$$

$$= -\log (4.0 \times 10^{-5})$$

$$pH = 4.4$$

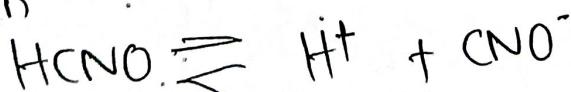
~~(0)~~ 1 mark
2

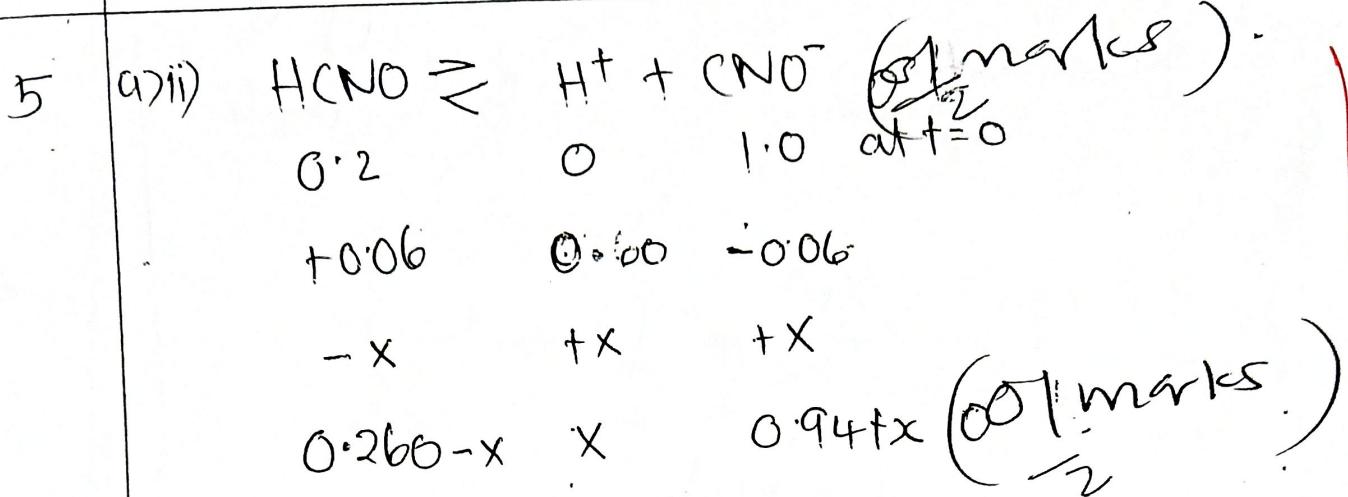
ii)

$$[HCl] = \frac{0.030 \text{ mol}}{0.5 \text{ L}} = 0.060 \text{ mol L}^{-1}$$

$$[HCl] = 0.060 \text{ mol L}^{-1} \quad (6 \text{ marks})$$

then





Assume $0.260-x = 0.260\text{M}$ and $0.94+x = 0.94$

then

$$K_a = \frac{[\text{H}^+][\text{CNO}^-]}{[\text{HCNO}]} \quad (0.1 \text{ mark})$$

$$= \frac{x \times 0.94}{0.26}$$

$$2.0 \times 10^{-4} = \frac{0.94x}{0.26}$$

$$x = \frac{0.26 \times 2.0 \times 10^{-4}}{0.94} \quad (0.2 \text{ mark})$$

$$x = 5.5 \times 10^{-5} \text{ M} = [\text{H}^+]$$

5

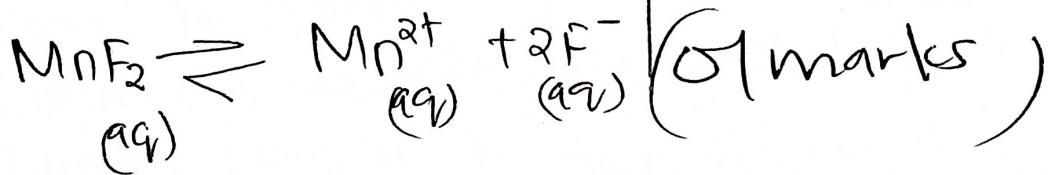
$$\text{a(ii). } \text{pH} = -\log[\text{H}^+]$$

$$-\log(5.5 \times 10^{-5})$$

$$\text{pH} = 4.26 \quad (\text{01 marks})$$

$$\text{(b) Molar solubility of MnF}_2 = \frac{6.609 \text{ g/L}}{92.99 \text{ g/mol}} = 0.071044 \text{ mol/L} \quad (\text{01 mark})$$

$$\text{Molar solubility} = 0.071044 \text{ mol/L}$$



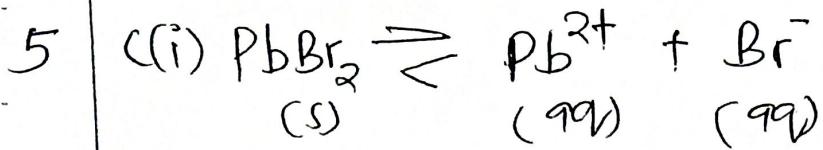
$$K_{\text{sp}} = [\text{Mn}^{2+}] [\text{F}^-]^2$$

$$[\text{Mn}^{2+}] = 0.071044 \text{ M}$$

$$[\text{F}^-] = 0.14209 \text{ M} \quad (\text{01 marks})$$

$$K_{\text{sp}} = [0.071044] [0.14209]^2$$

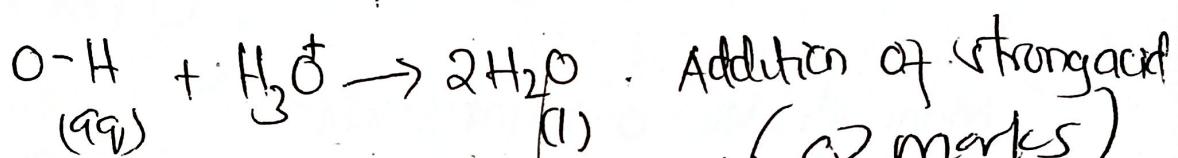
$$K_{\text{sp}} = 1.4 \times 10^{-3} \text{ M}^3 \quad (\text{01 marks}).$$



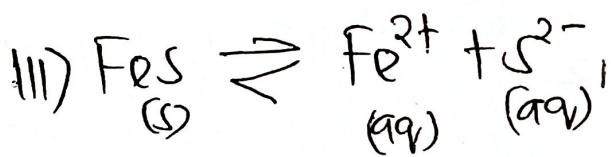
Br^- is the anion of HBr a strong acid so it does not react with H_3O^+ . It has no effect on its solubility. (02 marks)



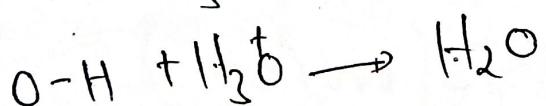
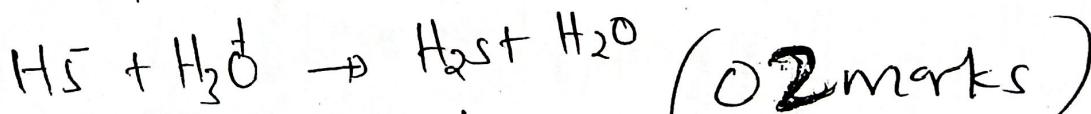
OH^- is the anion of H_2O It reacts with H_3O^+



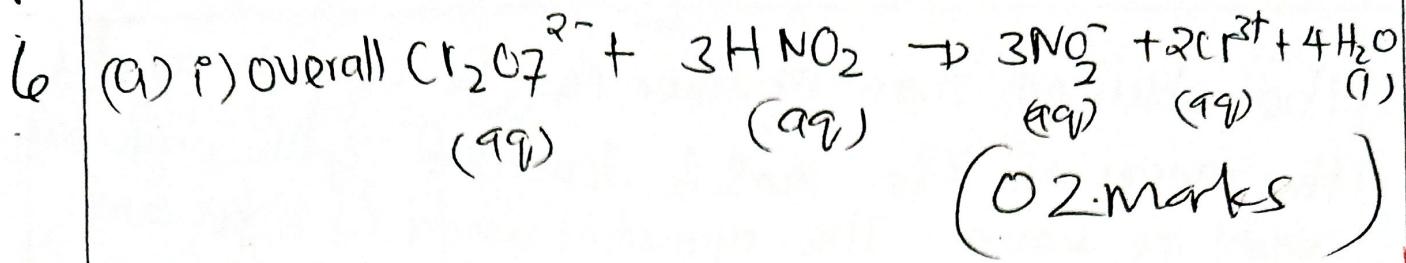
will cause an increase in solubility.



S^{2-} is the anion of H_2S is weak acid and strong base, it will react completely with water to form HS^- and O-H^- both of these ions will react with added H_3O^+

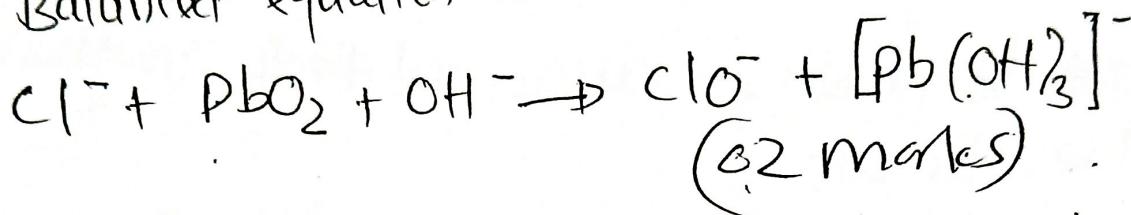


so addition of strong acid will cause an increase in solubility



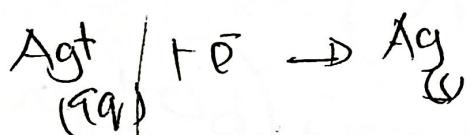
Step 1
part 1

ii) Balanced equation in basic media



Step 1
part 1

b(i) the cathodic reaction in the electrolytic cell containing AgNO_3 solution

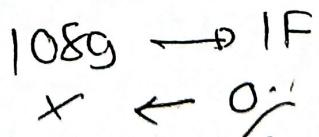


from the equation 1 mole of Ag^{I} requires 1 mole of electrons which is equivalent to 1F for complete reduction. The e⁻ equivalent weight of Ag^{I} is $= \frac{\text{Atomic weight of silver}}{\text{Valence of silver}}$

$$= \frac{108}{1}$$

$$= 108 \text{ g}$$

Thus the equivalent weight of silver is 108g. If 108g of Ag^{I} is equivalent to 1F, then x g of silver is equivalent to ~~0.5F~~ 0.5F

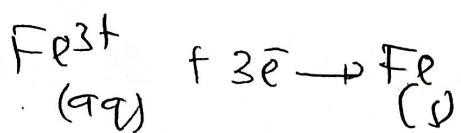
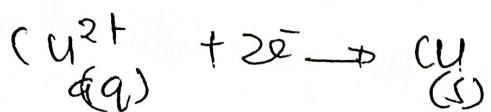


$$x = \frac{0.5 \text{ F} \times 108 \text{ g}}{1 \text{ F}} = 54 \text{ g}$$

(0.2 marks)

The obtained mass of silver can be used to calculate the masses of other metals deposited if the equivalent weight are known. The equivalent weight of copper and iron are obtained as follows

Cathodic reaction for CuSO_4 and FeCl_3 in their respective cells are



$$\text{Equivalent weight of Cu} = \frac{63.5g}{2} = 31.75g \quad (0.1 \text{ mark})$$

$$\text{Equivalent weight of Fe} = \frac{56g}{3} = 18.67g \quad (0.1 \text{ marks})$$

from Faradays law of electrolysis,

$$\frac{\text{Mass of silver deposited}}{\text{Mass of copper deposited}} = \frac{\text{Equivalent weight of silver}}{\text{Equivalent weight of copper}}$$

$$\frac{54g}{x} = \frac{108g}{31.75}$$

$$\text{Mass of Cu} = \frac{54g \times 31.75g}{108g} = 15.88g$$

$$\text{Mass of Cu} = 15.88g \quad (0.1 \text{ marks})$$

$$6(b)(i) \frac{\text{Mass of Ag}}{\text{Mass of Fe}} = \frac{E_{\text{Ag}}}{E_{\text{Fe}}}$$

$$= \frac{54\text{g}}{\text{M of Fe}} = \frac{108\text{g}}{18.67\text{g}}$$

$$M_{\text{Fe}} = \frac{54\text{g} \times 18.67\text{g}}{108\text{g}}$$

$$M_{\text{Fe}} = 9.33\text{g} \quad (01 \text{marks})$$

✓

$$(ii) \lambda_m^{\infty} = 3.88 \times 10^{-3} \text{ cm}^2 \text{ mol}^{-1}$$

$$\lambda_m = 5.2 \times 10^{-4} \text{ cm}^2 \text{ mol}^{-1}$$

$$\alpha = \frac{\lambda_m}{\lambda_m^{\infty}} = \frac{5.2 \times 10^{-4} \text{ cm}^2 \text{ mol}^{-1}}{3.88 \times 10^{-3} \text{ cm}^2 \text{ mol}^{-1}} = 0.13$$

α of CH_3COOH is 0.013 or 1.3%
(02 marks)

(b) C) solution.

Zn^{2+} is oxidized species

Cu^{2+} is reduced species

number of electrons involved in the reaction $n=2$

$$E^\circ_{\text{cell}} = E^\circ_{\text{Cu}^{2+}/\text{Cu}} - E^\circ_{\text{Zn}^{2+}/\text{Zn}}$$

$$E^\circ_{\text{cell}} = 0.34\text{V} - (-0.76\text{V}) = 1.1\text{V} \quad (01 \text{ marks})$$

from Nernst equation

$$E_{\text{cell}} = \Delta E^\circ + \frac{0.0591}{n} \log \left(\frac{[\text{Reduced species}]}{[\text{Oxidized species}]} \right) \quad (01 \text{ marks})$$

$$E_{\text{cell}} = 1.10\text{V} + \left[\frac{0.0591}{2} \log \left(\frac{5\text{M}}{0.05\text{M}} \right) \right] \text{V}$$

$$E_{\text{cell}} = 1.10\text{V} + \left[\frac{0.0591}{2} \log 100 \right] \quad (01 \text{ marks})$$

$$E_{\text{cell}} = 1.10\text{V} + 0.0591\text{V} = 1.16\text{V}$$

$$E_{\text{cell}} = 1.16\text{V} \quad (01 \text{ marks})$$

6 d) The intermediate species is NO_3 (01 marks)

$$R_{\text{forward}} = k_1 [\text{NO}] [\text{O}_2] \quad (01 \text{ marks})$$

$$R_{\text{reverse}} = k_{-1} [\text{NO}_3] \quad (01 \text{ marks})$$

$$R_2 = k_2 [\text{NO}_3] [\text{NO}] \quad (01 \text{ marks})$$

At equilibrium

$$R_1 = R_2$$

$$k_1 [\text{NO}] [\text{O}_2] = k_{-1} [\text{NO}_3] \quad (01 \text{ marks})$$

make $[\text{NO}_3]$ the subject

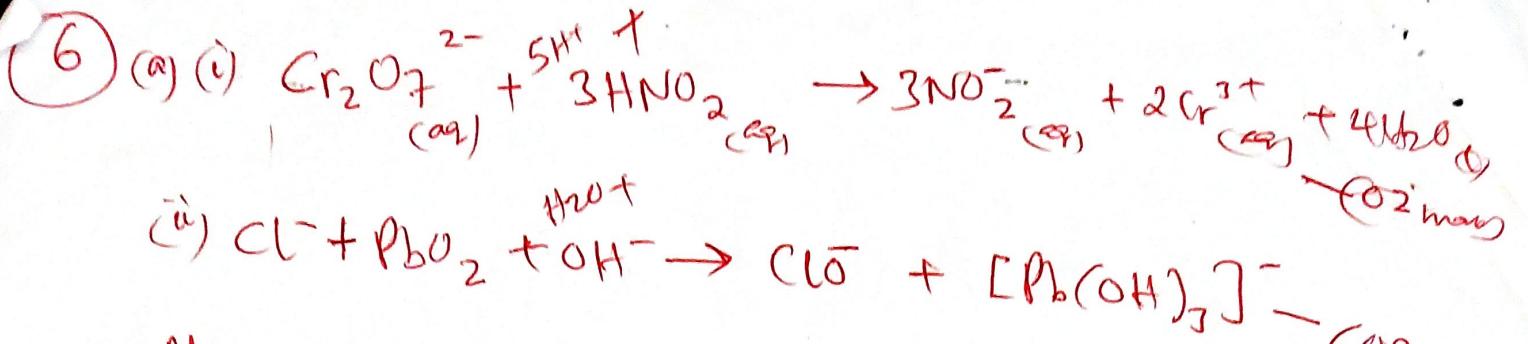
$$[\text{NO}_3] = \frac{k_1 [\text{NO}] [\text{O}_2]}{k_{-1}} \quad (01 \text{ marks})$$

Substitute the $[\text{NO}_3]$ to R_2 but $R_2 = k_2 [\text{NO}_3] [\text{NO}]$

$$R_2 = \frac{k_2 k_1 [\text{NO}] [\text{O}_2]}{k_{-1}} [\text{NO}] \quad (01 \text{ marks})$$

$$R_2 = k [\text{NO}]^2 [\text{O}_2] \quad (01 \text{ marks})$$

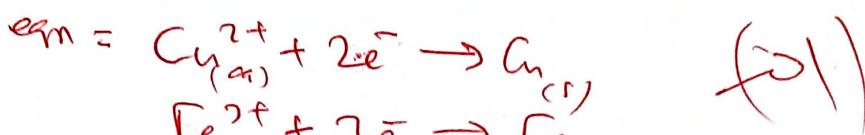
The proposed mechanism is consistent with the rate law.



(b) $M_{\text{Ag}} = 54.5 \text{ g}$ (01)

$M_{\text{Cu}} = 63.58 \text{ g}$ (01)

$M_{\text{Fe}} = 55.85 \text{ g}$ (01)



(i) $\alpha = 0.01\% \text{ or } 1.3\%$ (02)

(c) $E_{\text{cell}}^{\circ} = 1.1 \text{ V}$ (01)

$$\lambda = \frac{A_m}{B_m}$$

eqn = 01

entropies = 01

$E_{\text{cell}} = 1.16 \text{ V}$ (01)

(d) (i) Intermediate species = NO_2 (01 max)

(ii) $R_1 \text{ (forward)} = K_1 [\text{NO}][\text{O}_2]$ (01 max)

(iii) $R_{-1} \text{ (reverse)} = K_{-1} [\text{NO}_2]$ $\xrightarrow{-0.1\%}$

$R_2 = K_2 [\text{NO}_2][\text{NO}]$ $\xrightarrow{-0.1\% \text{ max}}$

$K_1 [\text{NO}][\text{O}_2] = K_{-1} [\text{NO}_2]$ (01)

$[\text{NO}_2] = \frac{K_1 [\text{NO}][\text{O}_2]}{K_{-1}}$ (01)

$R_2 = K_2 K_1 [[\text{NO}][\text{O}_2]] [\text{NO}]$ $\xrightarrow{-0.1\%}$

$R_2 = K [\text{NO}]^2 [\text{O}_2]$ $\xrightarrow{\text{Yes, the factor is constant}}$