G.C.E. (A/L) Examination
Chemistry - 2000

M.C.Q. Answers

(1) 5	(13) 5	(25) 3	(37) 5	(49) 1
(2) 4	(14) 3	(26) 1	(38) 5	(50) 3
(3) 5	(15) 4	(27) 2	(39) 4	(51) 3
(4) 4	(16) 3	(28) 2	(40) 5	(52) 1
(5) 3	(17) 3	(29) 4	(41) 1	(53) 2
(6) 4	(18) 4	(30) 1	(42) 4	(54) 5
(7) 5	(19) 1	(31) 1	(43) 2	(55) 1
(8) 1	(20) 2	(32) 3	(44) 4	(56) 3 or 4
(9) 3	(21) 5	(33) 2	(45) 3	(57) 3
(10) 2	(22) 5	(34) 3 or 5	(46) 4	(58) 3
(11) 1	(23) 3	(35) 4	(47) 1	(59) 5
(12) 3	(24) 3	(36) 3	(48) 4	(60) 4

PART A - STRUCTURED ESSAY

Answer all four questions. Each question carries 10 marks

01. (a)

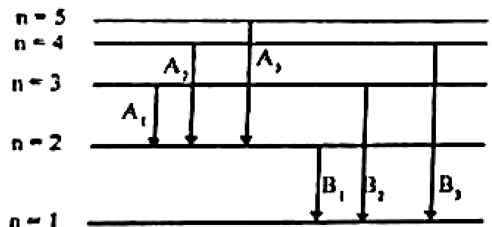
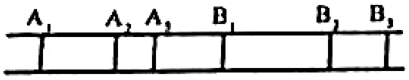


Figure 1



(i) Each Correct arrow 6×2 = (12)
(ii) Each Correct label 6×2 = (12)
(iii) increase (6)

(b) (i) L is Nitrogen (N) (5)
M is Phosphorus (P) (5)

(ii)		
from LCl_3	ammonia or ammonium hydroxide (5)	Chloric (I) acid or hypochlorous acid (5)
from MCl_3	hydrochloric acid or hydrogen chloride (5)	phosphoric (III) acid or (ortho) phosphorous acid (5)

$NCl_3 + 4H_2O \rightarrow NH_4OH + 3HOCl$ OR

$NCl_3 + 3H_2O \rightarrow NH_3 + 3HOCl$ (4)

$PCl_3 + 3H_2O \rightarrow P(OH)_3 + 3HCl$ (4)

OR

(H_3PO_3)

atom	oxidation number	valency
S_a	+4	6
S_b	0	2

$(4 \times 4 = 16)$

atom	oxidation number	valency
N_a	+4	5
N_b	+2	3

$(4 \times 4 = 16)$

2 (a) (i) $Mn^{2+} + 4H_2O \rightarrow MnO_4^- + 8H^+ + 5e$ (08)

$PbO_2 + 4H^+ + 2e \rightarrow Pb^{2+} + 2H_2O$ (03)

(ii) $Mn^{2+} : PbO_2 = 2:5$ (09)

(b) $128\ g\ CaC_2O_4 \longrightarrow 100g\ CaCO_3$ (05)

If x g of CaC_2O_4 is undecomposed, mass of reacted $CaC_2O_4 = 2 - x$ (05)

$\therefore\ (2 - x)\ g\ \text{Oxalate} \longrightarrow \frac{100(2-x)}{128} g$ carbonate

$\therefore\ 1.78 - x = \frac{100(2-x)g}{128}$ (05)

$\therefore\ 227.84 - 128x = 200 - 100x$

$\therefore\ x = 0.99\ \Omega 1g$ (10)

OR

Mass of CO liberated = $2.00 - 1.78 = 0.22$ g (5)

Number of CO moles = $\frac{0.22}{28}$ mol (5)

Mass of CaC_2O_4 decomposed = $\frac{0.22 \times 128}{28} = 1.01$ g (5)

Mass of CaC_2O_4 undecomposed = $2 - 1.01 = 0.99$ g $\Omega 1g$ (5)

(c) (i) $P_A = X_A P^o_A$ (02)

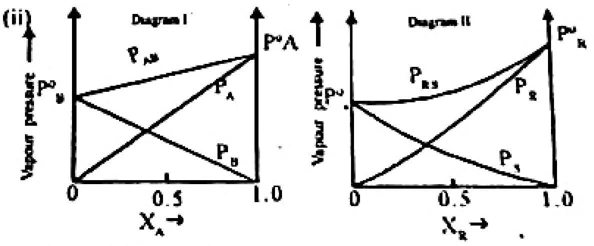
$P_B = (1-X_A)P^o_B$ (03)

$P_{AB} = P_A + P_B$ (02)

$= X_A P^o_A + (1-X_A)P^o_B$ (02)

Assumption :- Vapour phase behaves as an ideal gas. (03)

(ii)



Drawing 3 straight lines	3x1 = 3	Drawing 3 curves with slight curvature downwards	3x1=3
Labelling 2 straight lines	3x1 = 3	Labelling 3 curves	3x1= 3
Marking P^o_B and P^o_A	2x1 =2	Marking P^o_S and P^o_R	2x1 =2

If P^o_B is on same level as P^o_S $\rightarrow$ 2 marks
If P^o_A is on same level as P^o_R $\rightarrow$ 2 marks

Total = 20 marks

(iii) increase, external, atmospheric,,
B, A, R
negative, lower, higher $9 \times 2 = 18$

3. (a) Either 4 - formyl - 4- methyl -5-hexenoic acid
OR 4-formyl - 4- methylhex -5 - enoic acid

15 marks

(b) relative molecular mass of y = 90
percentage of C = $\frac{36}{90} \times 100 = 40\%$

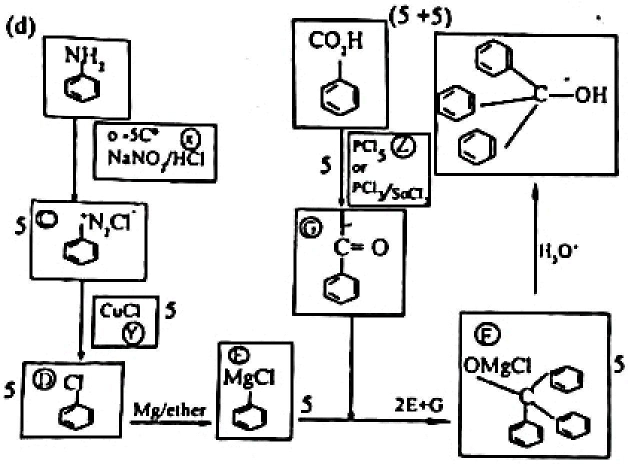
percentage of H = $\frac{6}{90} \times 100 = 6.7\%$

percentage of O = $\frac{48}{90} \times 100 = 53.3\%$

15 marks

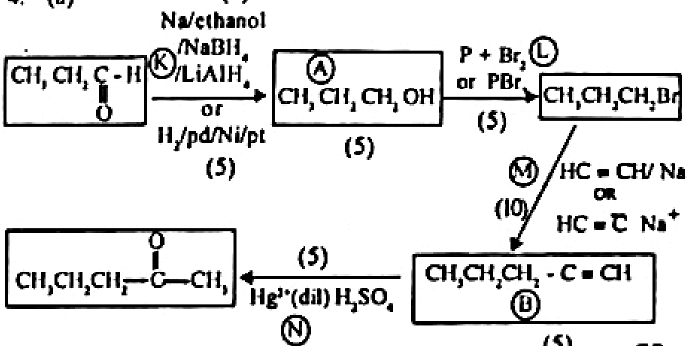
(c) (i) Nucleophilic, Addition (5 + 5)
(ii) H^{+} (5)
(iii) Electrophile (5)
(iv) SP^2 to SP^3 (5 + 5)

(d) (5 + 5)



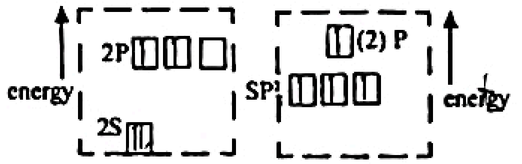
8 x 5 = 40

4. (a)



(5) (35)

4. (b)



Cage A : Ground State of carbon atom

Cage B : State of hybridisation of carbon atom in C.H

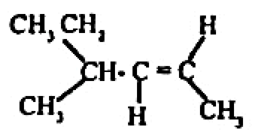
(ii) (I) P (3)
(iii) (II) SP^2 (3)

(19)

4.(c) (i)

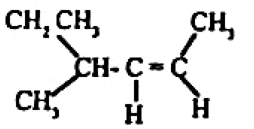
Compound	Structural formula	
P	$CH_3-\underset{}{CH}(CH_2CH_3)-CH=CH\,CH_3$	(8)
Q	$CH_3-CH(CH_2CH_3)-CH_2-CH=CH_2$	(8)
R	$CH_3-CH(CH_2-CH_2-CH_3)-CH=CH_2$	(8)
S	$CH_3-CH(CH_2CH_3)-CH_2-CH_2-CH_3$	(6)

Geometrical Isomer I



(5)

Geometrical Isomer II



(5)

PART B - ESSAY

5. (a) (i) Equal volumes of gases at the same temperature and same pressure contain equal numbers of molecules (10)

The Law applies to

Either	Ideal Gas Systems
OR	Perfect Gas Systems
OR	Gases obeying ideal gas equation
OR	Gases obeying PV = nRT
OR	Gases obeying Gas Laws
OR	Gases obeying Boyle and Charles Law

(5 marks)

(ii) For gas A, $P_AV_A = \frac{1}{3}m_AN_A\bar{C}_A^2$ (4)

For gas B, $P_BV_B = \frac{1}{3}m_BN_B\bar{C}_B^2$ (4)

At the same pressure and volume for A and B.

$\frac{1}{3}m_AN_A\bar{C}_A^2 = \frac{1}{3}m_BN_B\bar{C}_B^2$

so that $m_AN_AC_A^2 = m_BN_BC_B^2$ (4)

Also the same temperature

$\frac{1}{2}m_A\bar{C}_A^2 = \frac{1}{2}m_B\bar{C}_B^2$ (8)

So that $N_A = N_B$ (20)

(b) (i) $n = \frac{PV}{RT}$ (4)

$n_B = \frac{(2 \times 10^5 Nm^{-2})(5m^3)}{8.314\ J\ mol^{-1}K^{-1}(300K)}$ (4)

$= 400.9$ mol (4)

(ii) $n_A = \frac{(1 \times 10^5 Nm^{-2})(10m^3)}{8.314J\ mol^{-1}K^{-1}(400K)}$ (4)

$= 300.7$ mol (4)

(iii) $n_A + n_B = 701.6$ mol (2+2)

(iv) $P_A = P_B$ (8)

$\therefore \frac{n_A RT_A}{V_A} = \frac{n_B RT_B}{V_B}$

$\therefore \frac{(701.6 - n_B)\ 400K}{10m^3} = \frac{n_B \times 300K}{5m^3}$ (4)

$\therefore 4(701.6 - n_B) = 6n_B$

Hence $n_B = 280.6$mol (4)

$\therefore P_B = \frac{(280.6mol)(8.314J\ mol^{-1}K^{-1})(300K)}{5m^3}$

$= 1.40 \times 10^5 Nm^{-2}$ (4)

(v) Mole fracton of ethene in A = $\frac{\text{Total number of ethene moles}}{\text{Total number of moles}}$ (4)

$= \frac{400.9}{701.6}$ (4)

partial pressure of ethene in A = (mole fraction) x (Total Pressuere)

$= \frac{400.9}{701.6} \times 1.4 \times 10^5 Nm^{-2}$ (4)

$= 8 \times 10^4 Nm^{-2}$ (4)

(16 marks)

(c) (i) $PH = -\log C_{H^+}/moldm^{-3}$

$\therefore (C_{H^+})_{aq} = 10^{-4}\ moldm^{-3}$ (9)

(ii) $HA_{(aq)} \rightleftharpoons H^+_{(aq)} + A^-_{(aq)}$

$$K = \frac{[H^+(aq)][A^-(aq)]}{[HA(aq)]} \qquad (4)$$

$[H^+_{(aq)}] = [A^-_{(aq)}]$ (4)

$\therefore [HA^*_{(aq)}] = \dfrac{(10^{-4}\text{mol dm}^{-3})^2}{10^{-7}\text{mol dm}^{-3}}$ (4)

$= 0.1 \text{ mol dm}^{-3}$ (4)

16

(iii) HA moles in aq layer (initially) $= \dfrac{0.5 \times 100}{1000}$ (2)

HA moles in aq layer (finally) $= \dfrac{0.1 \times 100}{1000}$ (2)

HA moles in organic layer $= 0.05 - 0.01 = 0.04$ mol

$\therefore [HA]org = \dfrac{0.04}{50} \times 1000$ (4)

$= 0.8 \text{mol dm}^{-3}$ (2)

12

(iv) P. coeffecient $= \dfrac{C_{HA}(org)}{C_{HA}(aq)}$ (5)

$= 8$ (4)

OR $\dfrac{C_{HA}(aq)}{C_{HA}(org)}$

$= 0.125$

9

(v) Degree of dissociation $\propto$ in the aqueous layer

$\propto = \dfrac{(C_{H^+})_{aq}}{[HA]_{(aq)}}$ (5)

$= \dfrac{10^{-4} \text{ mol dm}^{-3}}{0.1\text{mol dm}^{-3}}$ (2)

$= 0.001$ (2)

5 (C) Total 55 marks.

(b) (i) Standard EMF $= E^0_{Pb^{2+}/Pb} - E^0_{Mg^{2+}/Mg}$

Or $= E_{cathode} - E_{anode}$

Or $= E_{RHS} - E_{LHS}$

Standard EMF $= -0.126 - (-2.37)V$ (10)

$= 2.244$ V

(ii) $Mg_{(s)} / Mg^{2+}_{(aq, 1 mol dm^{-3})} // Pb^{2+}_{(aq, 1 mol dm^{-3})} / Pb(s)$ (10)

(iii) Cathode (+) : $Pb^{2+}_{(aq)} + 2e \longrightarrow Pb(s)$ (15)

Anode (-) : $Mg_{(s)} \longrightarrow Mg^{2+}_{(aq)} + 2e$

[correct identification of cathode (+) or anode (-) (5)]

[all reaction correct as shown below $5 \times 2 = 10$)

$4 \times 3 = (12)$

(c) (i) $X_Q = 0.2 ; X_A = 0.3 ; X_B = 0.3$

(ii) $K_p = \dfrac{P_P \times P_Q}{P_A \times P_B}$ (4)

If total pressure $= P$, (4)

$P_P = 0.2P = P_Q$ (4)

$P_A = 0.3P = P_B$

$\therefore K_p = \dfrac{0.2P \times 0.2P}{0.3P \times 0.3P} = \dfrac{4}{9}$ (4)

(iii) 400°C

$X_B = 0.2$; Hence, $X_P = 0.3$; $X_Q = 0.3$ $4 \times 3 = (12)$

(iv) Mole fractions (concentrations) of products have increased from 200 to 400 °C (2)

Therefore reaction is endothermic (2)

$\therefore$ Enthalphy change is positive (4)

(v) Le Chatelier's Principle (4)

(vi) No effect on the composition of the equilibrium mixture (8)

6 (C) Total 60 marks

6. (a) (i) $Ag_2CrO_{4(s)} \rightleftharpoons 2Ag^+_{(aq)} + CrO^{2-}_{4(aq)}$ (3)

$$K = \frac{[Ag^+(aq)]^2[CrO^{2-}_{4(aq)}]}{[Ag_2CrO_{4(s)}]} \qquad (3)$$

$[Ag_2CrO_4(s)]$ is taken as a constant. (3)

$K_{sp} = [Ag_{(aq)}]^2 [CrO^{2-}_{4(aq)}]$ (3)

(ii) Let solubility of $Ag_2CrO_4(s)$ in water = s mol dm^{-3}

$\therefore [Ag^+_{(aq)}] = 2s$ (4)

$[CrO^{2-}_{4(aq)}] = s$ (2)

$\therefore K_{sp} = (2s)^2 s$ (4)

$\therefore s = 10^{-4}$ moldm^{-3} (6)

16

(iii) Let solubility of $Ag_2CrO_4(s)$ in $AgNo_3$ Solution = x mol dm^{-3}

$\therefore [Ag^+_{(aq)}] = (0.2 + 2x)$ mol dm^{-3} (5)

$[CrO^{2-}_4(aq)] = x$

$K_{sp} Ag_2CrO_4 = (0.2 + 2x)^2 x$ (4)

Since X <<<< 0.2 (2)

$\therefore K_{sp} \;\Omega\; 0.04\,x$ (2)

Hence, $x = \dfrac{4 \times 10^{-12}}{0.04}$ (2)

Molar mass of of $Ag_2CrO_4(s)$ = 332 g mol-1 (2)

Solubility of $Ag_2CrO_4(s) = \left[\dfrac{332 \times 500}{1000}\right]\left[\dfrac{4 \times 10^{-12}}{0.04}\right]$ g in 500 cm^3

$= 1.66 \times 10^{-10}$ g (6)

7. (a) (i) Heat Liberated

$= [25 \times 10^{-6}m^3)(1000kgm^{-3})[5000Jkg^{-1}K^{-1}][8K]$ (5)

$= 1$ KJ (5)

(ii) Either $Na_2CO_3 + 2HCl \longrightarrow 2NaCl + H_2O + CO_2$

Or 0.025 mol Na_2CO_3 (s) requires 0.05 mol HCl for complete reaction (5)

But amount of HCl present $= \dfrac{3 \times 25}{1000} = 0.075$mol (5)

Enthalpy of Neutralisation per mole of HCl reacted $= \dfrac{-1 kJ}{0.05mol}$ (5)

$= -20kJ$ (5)

Assumption : Neglecting the enthalphy of solution

OR

enthalphy change of the solution/ dissolution of $Na_2CO_3(s)$ (5)

(iii) using thermochemical cycle :

$2HCl_{(aq)} + 2\,NaHCO_{3(s)} \xrightarrow{\Delta H^\circ} Na_2CO_{3(s)} + H_2O_{(l)} + CO_{2(g)} + 2\,HCl_{(aq)}$

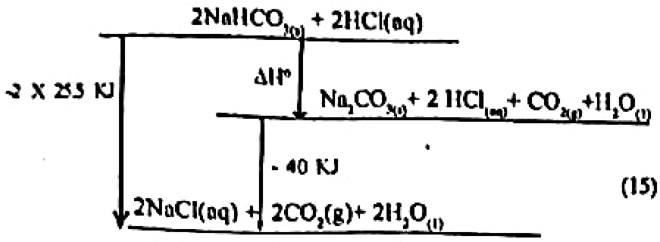
-2 X 25.5 KJ   -2 X 20 KJ

$2NaCl_{(aq)} + 2H_2O_{(l)} + 2CO_{2(g)}$ (10)

$\Delta H^\circ - 40^\circ = -51$ KJ (5)

$\therefore \Delta H^\circ = -11$ kJ (5)

OR using Enthalphy Diagram :



(15)

$\Delta H^{\circ} - 40\ KJ = -2 \times 25.5\ KJ$

$\therefore \Delta H^{\circ} = -11\ kJ$ (5)

Or By algebraic manipulation

$2NaHCO_{3(s)} + 2HCl_{(aq)} \longrightarrow 2NaCl_{(aq)} + 2CO_{2(g)} + 2H_2O_{(l)}$
$\Delta H^{\circ} = -51\ kJ$ (A) (5)

$Na_2CO_{3(s)} + 2HCl_{(aq)} \longrightarrow 2NaCl_{(aq)} + CO_{2(g)} + H_2O_{(l)}$
$\Delta H^{\circ} = -40\ kJ$ (B) (5)

Subtracting (B) from (A) gives (5)

$2NaHCO_{3(s)} - Na_2CO_{3(s)} \longrightarrow CO_2(g) + H_2O_{(l)}$
$\Delta H^{\circ} = -11\ kJ$

Required Enthalphy Change = - 11 KJ (5)

(b) Algebraic Manipulation

$K_{(s)} + 1/2Cl_{2(g)} \longrightarrow KCl_{(s)}$	$\Delta H^{\circ}_f = -437kJ$	(A)
$K_{(s)} \longrightarrow K_{(g)}$	$\Delta H^{\circ}_s = +89kJ$	(B)
$1/2Cl_{2(g)} \longrightarrow Cl(g)$	$\Delta H^{\circ}_D = +1/2 \times 244kJ$	(C)
$K(g) \longrightarrow K^+_{(g)} + e$	$\Delta H^{\circ}_I = +418kJ$	(D)
$Cl(g) + e \longrightarrow Cl^-_{(g)}$	$\Delta H^{\circ}_{EA} = -349$	(E)

5 x 3 = (15)

Adding (B), (C), (D) and (E) gives

$(K)_{(s)} + 1/2Cl_{2(g)} + K(g) + Cl(g) + e \longrightarrow K_{(g)} + Cl_{(g)} + K^+_{(g)} + Cl^-_{(g)} + e$

$\Delta H^{\circ} = +89 + 122 + 418 - 349kJ$

ie $K_{(s)} + 1/2Cl_{2(g)} \longrightarrow K^+_{(g)} + Cl^-_{(g)}$ $\Delta H^{\circ} = +280kJ$ (F)

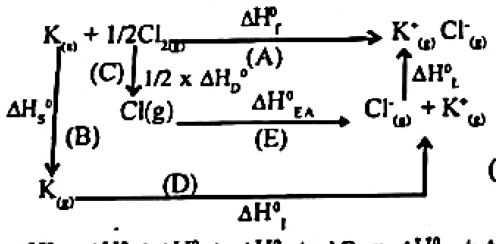
ie $K^+_{(g)} + Cl^-_{(g)} \longrightarrow K_{(s)} + 1/2Cl_{2(g)}$ $\Delta H^{\circ} = -280kJ$ (G)

Adding (A) to (G) gives (15)

$K^+_{(g)} + Cl^-_{(g)} \longrightarrow KCl_{(s)}$ $\Delta H^{\circ} = -437 - 280 = -717kJ$ (H)

Standard Lattice Enthalphy of KCl(s) = -717 KJmol⁻¹ (10)

OR using the Thermochemical cycle.



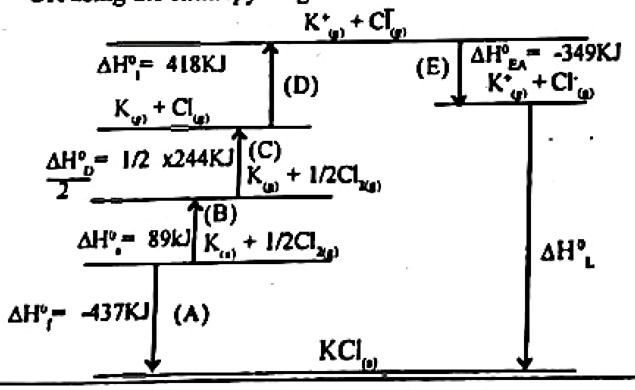
(5 x3 = 15)

$\Delta H^{\circ}_f = \Delta H^{\circ}_s + \Delta H^{\circ}_I + \Delta H^{\circ}_L + 1/2 \times \Delta H^{\circ}_D + \Delta H^{\circ}_{EA}$ (10)

$-437 = 89 + 418 + \Delta H^{\circ}_L + 1/2 \times 244 - 349$ (5)

$\Delta H^{\circ}_L = -717\ KJ\ mol^{-1}$ (10)

OR using the enthalpy diagram.



Each level with reactants = 3 marks x 6 = (18)

Each enthalpy values = 2 marks x 6 = (12)

$-437\ KJ = 89 + 1/2 \times 244 + 418 - 349 + \Delta H^{\circ}_L\ KJ$

$\therefore \Delta H^{\circ}_L = -717\ KJ\ mol^{-1}$ (10)

(40)

(c) (i) A (terminal) 'O' atom of O_3 molecule must collide with the 'N' atom of NO molecule. (6)

The colliding molecules must have the necessary activation energy between them (4)

(ii) Establish catalytic feature by

- preparing a solution containing a known concentration of OH^- ions. (2)
- adding a known volume of this solution to an aqueous solution of H_2O_2 (3)
- after allowing the reaction to go to completion, show that the amount of OH^- remains unchanged by titrating with a standard solution of HCl methyl orange /red indicator (10)

(iii) Rate α amount of Br_2 formed $dm^{-3}s^{-1}$ (5)

$\therefore$ amount of Br_2 formed $dm^{-3}s^{-1} \propto [Br^-]^x [BrO_3^-]^y [H^+]^z$ (4)

$= K [Br^-]^x [BrO_3^-]^y [H^+]^z$

$$\frac{9.60 \times 10^{-6}}{2.40 \times 10^{-6}} = \frac{k\,[0.040]^x\,[0.200]^y\,[0.200]^z}{k[0.010]^x\,[0.200]^y\,[0.200]^z} \quad (3)$$

$\therefore\ 4 = 4^x$

$\therefore\ x = 1$ (2)

$$\frac{9.60 \times 10^{-6}}{2.40 \times 10^{-6}} = \frac{k[0.020]\,[0400]^y\,[0.200]^z}{k[0.020]\,[0.400]^y\,[0.100]^z} \quad (5)$$

$\therefore\ 4 = 2^z$

$\therefore Z = 2$ (4)

$$\frac{9.60 \times 10^{-6}}{9.6 \times 10^{-6}} = \frac{k[0.040]\,[0.200]^y\,[0.200]^z}{k[0.020]\,[0.400]y\,[0.200]^z} \quad (3)$$

$$1 = 2\left(\frac{1}{2}\right)^y \quad (2)$$

$\therefore Y = 1$ (2)

PART C - ESSAY

8. (i) $1s^2, 2s^2, 2P^6, 3S^2, 3P^6, 3d^6, 4s^2$

OR

$1s^2, 2s^2, 2P^6, 3s^2, 3P^6, 4s^2, 3d^6$ (10)

(ii) +2 and +3 2 x 5 = (10)

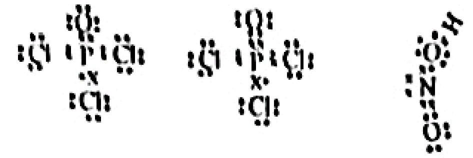
(iii)

	Either	OR	OR	OR	OR	OR
Reagent	add NH_4CNS	add $K_4Fe(CN)_6$	add $K_3Fe(CN)_6$	add acidified $KMnO_4$	add dil NaOH	pass H_2S
+2	No Change	White ppt	Blue ppt/ colour	decolorized	green ppt	No Change
+3	red colour	Blue ppt/ colour	No ppt	No Change	brownish ppt	White ppt

Any one of the above six reagents (5)

Any one relevent correct observation (5)

(b) (i) Either OR



(2 x 10 = 20)

(ii) ClO_4^- = tetrahedral (10)

PH_3 = pyramidal (10)

(c) (i) $[CoCl(NH_3)_5]Br_2$ OR $[Co(NH_3)_5Cl]Br_2$ (10)

(ii) Potassium iron (II) hexacyanoferrate (II)

OR iron (II) potassium hexacyanoferrate (II) (10)

(d) M = Cu (10)

(i) $Cu^{2+} + H_2O \longrightarrow [Cu(H_2O)_4]^{2+}$ (5)

(ii) $[Cu(H_2O)_4]^{2+} + NH_3 \longrightarrow [Cu(NH_3)_4]^{2+}$ OR $[Cu(NH_3)_4(H_2O)_2]^{2+}$ (5)

(iii) $Cu^{2+} + HCl \longrightarrow [CuCl_4]^{2-}$ (5)

(iv) $[CuCl_4]^{2-} + H_2O \longrightarrow [Cu(H_2O)_4]^{2+}$ OR $[Cu(H_2O)_4]^{2+} + H_2S \longrightarrow CuS$ (5)

(e) Cr^{3+} add $NH_4Cl + NH_4OH$ OR $NH_4OH \longrightarrow$ greenish ppt

OR Heat with $NaOH + H_2O_2 \longrightarrow$ yellow/greenish yellow/ yellow green colouration

OR add H_2O_2 + acid $\longrightarrow$ blue colouration

Any one of the above tests (3)

correct relevant observation. (3)

Zn^{2+}

Warm with NaOH, filter and then acidify filtrate gradually $\longrightarrow$ white ppt

OR Warm with NaOH, filter and pass H_2S through the filterate $\longrightarrow$ white ppt (4+3)

Ni^{2+}

Add (NH_4OH) + dimethyl glyoxime $\longrightarrow$ red(pint) ppt

OR Add $(NH_4Cl) + NH_4OH$ (ammonia)

Filter & pass H_2S through the filterate $\longrightarrow$ black ppt (4+3)

(f) Since O is more electronegative than S, (3)

O-H bond is more polar than S-H bond (3)

There is hydrogen bonding in H_2O but not in H_2S

OR There is stronger hydrogen bonding in H_2O than H_2S (4)

9. (a) (i) $Cl_2 + H_2S \longrightarrow 2HCl + S$

$5H_2S + 2MnO_4^- + 6H^+ \longrightarrow 5S + 2Mn^{2+}\ 8H_2O$

$3H_2S + Cr_2O_7^{2-} + 8H^+ \longrightarrow 3S + 2Cr^{3+}, 7H_2O$

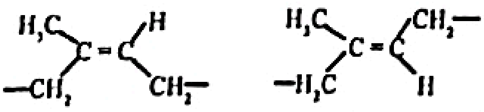
$2H_2S + 3O_2 \longrightarrow 2H_2O + 2SO_2$ (5)

(ii) $H_2S + 2Na \longrightarrow Na_2S + H_2$ OR $2H_2S + 2Na \longrightarrow 2NaHS + H_2$ (5)

(iii) $3CuO + 2NH_3 \longrightarrow 3Cu + N_2 + 3H_2O$ (5)

(iv) $2Na + 2NH_3 \longrightarrow 2NaNH_2 + H_2$ (5)

(b) (i)



Cis Trans (12)

(ii) Cis from (4)

(iii) Cis from (4) coiled or irregular (4) and therefore easily stretchable. (4)

(iv) any two of the following

more heat resistant

abrasive resistant

higher strength/hardness

controls elasticity

high oil resistance. 2 x 4 = 8

(v) formation of sulphur cross - links (4)

(c) $H_2SO_4 + 2CH_3COONa \longrightarrow 2CH_3COOH + 2Na_2SO_4$

OR $2H^+ + SO_4^{2-} + 2CH_3COO + 2Na^+ \longrightarrow 2CH_3COOH + 2Na^+ + SO_4^{2-}$ (5)

Amount of CH_3COONa that reacts with H_2SO_4 present $= \dfrac{2 \times 0.2 \times 50}{1000}$ mol (5)

Amount of CH_3COONa remaining after reaction with H_2SO_4 = Amount of CH_3COONa (initial) - amount of CH_3COONa (reacted) (2)

$= \left[\dfrac{0.8 \times 50}{1000} - \dfrac{0.4 \times 50}{1000}\right]$ mol (4)

$= \dfrac{0.4 \times 50}{1000}$ mol

Amount of CH_3COOH formed and present in final reaction mixture $= \left[\dfrac{0.4 \times 50}{1000}\right]$ mol (4)

The resultant solution is a buffer because it contains a mixture of a weak acid and the salt of the acid with strong base. (5)

(d) (i) Either $Fe + H_2SO_4 \longrightarrow FeSO_4 + H_2$

OR $Fe + 2H^+ \longrightarrow Fe^{++} + H_2$ (5)

$Fe_2O_3 + 3H_2SO_4 \longrightarrow Fe_2(SO_4)_3 + 3H_2O$ (10)

(ii) $5Fe^{2+} + KMnO_4 + 8H^+ \longrightarrow 5Fe^{3+} + Mn^{2+} + K^+ + 4H_2O$ (10)

OR $5Fe^{2}, KMnO_4^- + 8H^+ \longrightarrow 5Fe^{3+} + Mn^{2+} + 2H_2O$

OR

$5Fe^{2+} \longrightarrow 5Fe^{3+} + 5e$ (5)

$MnO_4^- + 8H^+ + 5e \longrightarrow Mn^{2+} + 4H_2O$ (5)

OR

$10Fe^{2+} + 2KMnO_4 + 18H_2SO_4 \longrightarrow 5Fe_2(SO_4)_3 + 2MnSO_4 + K_2SO_4 + 8H_2O + 20H^+$ (10)

(iii) Amount of $KMnO_4$ reacted $= 25 \times \dfrac{0.02}{1000}$ mol (4)

Amount of Fe^{2+} present $= 25 \times \dfrac{0.02}{1000} \times 5$ mol (4)

Mass of pure Fe present in 0.30 g of corroded iron nail. $= 25 \times \dfrac{0.1}{1000} \times 56$g (4)

Mass of Fe_2O_3 present as rust in corroded iron nail $= (0.30 - 25 \times \dfrac{0.1}{1000} \times 56)$g (4)

$= 0.30 - 0.14 = 0.16$g

$\therefore$ Moles of Fe present as rust in corroded iron nail $= \dfrac{2 \times 0.16}{160}$ (4)

$\therefore$ Mass of Fe present as rust in corroded iron nail $= \left(\dfrac{2 \times 0.16}{160} \times 56\right)$ g (4)

$\therefore$ Mass of uncorroded iron nail =

$\left[\dfrac{2 \times 0.16 \times 56}{160} + \dfrac{25 \times 0.1 \times 56}{1000}\right]$ g (4)

$= (0.112 + 0.14)$ g

$= 0.252$g (7)

9 d - (60 Marks)

8) (a)

(i) Benificial organisms (animals) are destroyed. Therefore, natural equilibrium of the biosystem is destroyed.

OR Chemicals are toxic to beneficial organisms. Therefore beneficial organisms are destroyed.

(ii) Bacteria (Micro-organisms) in the water bodies are increased. Therefore, oxygen required in the water bodies for the growth of algae (microplants) is destroyed.

OR Food chain is destroyed.

(iii) Toxic chemicals enter the human body through air (water/ food) Therefore, disease (death) to human beings.

(iv) Break-down products such as halogenns NO_2 Or N_2O, enter the atmosphere.
Therefore, the Ozone layer is affected (destroyed)

(v) Added chemicals lead to soil degradation (Acidification). Therefore, productivity of the land is affected.

Cause of Pollution - 5 marks each x 3
Effect due to cause - 5 marks each x 3 (30 marks)

(b) (i) $S + O_2 \longrightarrow SO_2$ (5)

$2SO_2 + O_2 \xrightarrow[\text{hightemp}]{\text{Catalyst}} 2SO_3$ (5)

Identifying the catalyst V_2O_5
Identifying the temperature 450°C (5)

$SO_3 + H_2O \longrightarrow H_2SO_4$ (5)

OR

$SO_3 + \text{conc. } H_2SO_4 \longrightarrow H_2S_2O_7$

$H_2S_2O_7 + H_2O \longrightarrow 2H_2SO_4$

(ii) $SO_2 + H_2O \longrightarrow H_2SO_3$ (5)

$O_2 + 2H_2SO_3 \longrightarrow 2H_2SO_4$ (5)

(iii) $CaCO_3.MgCO_3 + 2H^+ \longrightarrow Ca^{2+} + Mg^{2+} + 2HCO_3^-$

OR $CaCO_3.MgCO_3 + H_2SO_4 \longrightarrow Ca^{2+}, Mg^{2+} + 2HCO_3^- + SO_4^{2-}$ (10)

and

$CaCO_3.MgCO_3 + 4H^+ \longrightarrow Ca^{2+} + Mg^{2+} + 2H_2O + 2CO_2$ (5)

(iv) Concentration of Ca^{2+} and Mg^{2+} in ground water increases. ∴ Hardness of ground water increases. (3 +2)

(v) Ground water will be hardwater. More soap is required for washing. Deposition of $CaCO_3$ (scales) when water is boiled. (2x5=10)

Total 60 marks

(c) (i) $(NH_4)_2SO_4 + 2NaOH \longrightarrow 2NH_3 + Na_2SO_4 + 2H_2O$ (5)

$NH_2CONH_2 + 2NaOH \longrightarrow 2NH_3 + Na_2CO_3$ (10)

(ii) $(NH_4)_2SO_4 + 2HNO_3 \longrightarrow 2NH_4NO_3 + H_2SO_4$

$BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + 2HCl$ (5)

OR

$BaCl_2 + (NH_4)_2SO_4 \longrightarrow BaSO_4 + 2NH_4Cl$

From reaction (ii)

Either 233 g (1 mole) of $BaSO_4$ arises from 1 mole of $(NH_4)_2SO_4$

or 0.233g $BaSO_4$ arises from 0.001 mol $(NH_4)_2SO_4$ (5)

100 cm³ of liquid fertiliser containing 0.001 mol $(NH_4)_2SO_4$ will require 0.002 mol of NaOH for complete reaction of $(NH_4)_2SO_4$ (5)

Amount of NaOH that reacts with the urea in 100cm³ of liquid fertiliser

= Total amount of NaOH reacted - NaOH reacted with $(NH_4)_2SO_4$ (5)

$= \frac{0.08 \times 100}{1000} - 0.002$ mol (5)

= 0.006 mol (5)

Amount of urea in 100cm³ fertiliser $= \frac{1}{2} \times 0.006 = 0.003$ mol (5)

∴ Concentration of $(NH_4)_2SO_4$ in liquid fertiliser

$= \frac{0.001 \times 1000}{100}$

$= 0.01 \text{ mol dm}^{-3}$ (5)

∴ Concentration of urea in liquid fertiliser

$= \frac{0.003 \times 1000}{100}$

$= 0.03 \text{ mol dm}^{-3}$ (5)

Total= 60 marks