G.C.E. (A/L) Examination
Chemistry - 2003

M.C.Q. Answers

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

PART A - STRUCTURED ESSAY

Answer all four questions. Each question carries 10 marks.

(01) (a) (i) Li (Lithium) (3)

(ii) C (Carbon) (3)

(iii) Li (Lithium) (3)

(iv) C (Carbon), (N), (Nitrogen) (3 + 3)

(v) F (Fluorine), (Ne), (Neon) (3 + 3)

(vi) Be (Beryllium), B (Boron) (3 + 3)

(b) (i) Diffusion of gases or compressibility (08)

(ii) Dissolution of coloured salts or Mixing with other liquids or Brownian motion (08)

(iii) Diffraction or Deflection of α particles. (09)

(c) A = Al D = Si E = P (3 x 8 = 24)

(d) atomic number; metals; Most; non-metals; All; same; different; protons (3 x 8 = 24)

(02) (a) (i) $2\begin{matrix}COOH\\COOK\end{matrix} \cdot xH_2O \rightarrow K_2CO_3 + 2CO + CO_2 + (2x-1)H_2O$ (10)

(ii) $^{\circ}K_2CO_3 = \frac{1.38}{138} = 0.01$ mol (04)

$^{\circ}H_2O = \frac{0.90}{18} = 0.05$ mol (04)

$^{\circ}\begin{matrix}COOH\\COOK\end{matrix} \cdot xH_2O = 0.02$ mol

$\frac{2x+1}{1} = \frac{0.50}{0.01}$ (05)

$x = 2$ (07)

(30)

(b) (i) $2NH_4^+ + H_2O \rightarrow N_2O + 10H^+ + 8e$ (10)

(ii) $2NO_3^- + 10H^+ + 8e \rightarrow N_2O + 5H_2O$ (10)

(c) (i) $\frac{d}{x} = \frac{e}{y} = \frac{f}{z}$ any one (03)

(ii) I. $\left(\frac{x}{x+y}\right) J$ (05)

II. $\frac{x}{x+y} J + \frac{y}{x+y} K$ OR (05)

$\frac{xJ+yk}{x+y}$

III. $\frac{xJ+yk}{x+y} \frac{s}{RT} \frac{d}{x}$ OR

$\frac{xJ+yk}{x+y} \frac{s}{RT} \frac{e}{y}$ OR

$\frac{xJ+yk}{x+y} \frac{s}{RT} \frac{f}{z}$ (05)

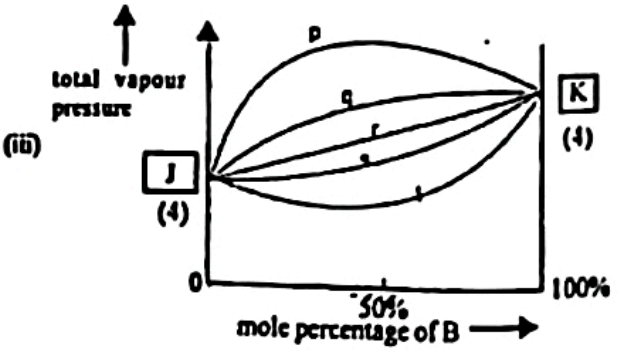
IV. $\frac{xJ}{yk}$ (05)

V. $\frac{Sck}{RT(x+y)} = \frac{yKsd}{xRT(x+y)} = \frac{yKsf}{zRT(x+y)}$ (any one - 06)

VI. $\frac{3RT}{L}$ (05)

(34)

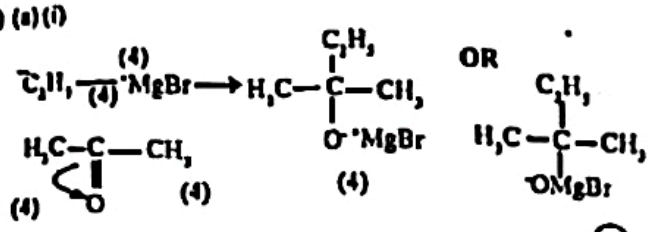
(iii)



I. Solution AB : r (04)

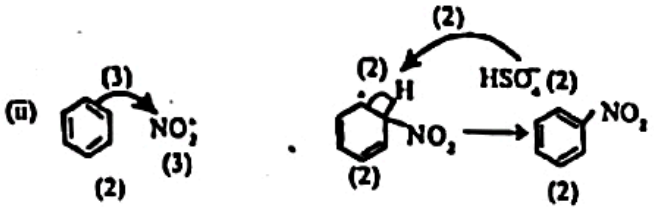
Solution BC : S (04)

(3) (a) (i)



(20)

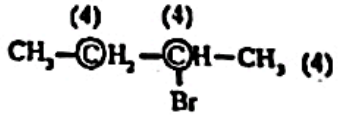
(ii)



conc H_2SO_4 / conc HNO_3 (2)

(20)

(b) (i)



(4)

(12)

(ii) (i) (SP^2), (SP^3) (4)

(ii) planar triangular (2)
tetrahedral (2)

(iii) Electrophilic Addition (5)
Nucleophilic Substitution (5)

(30)

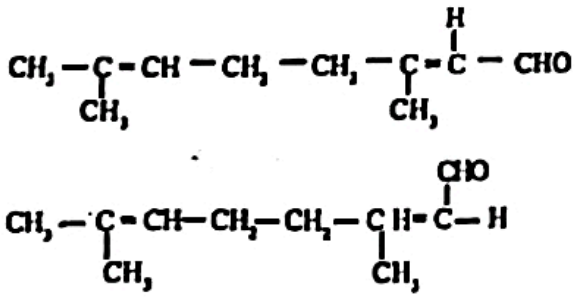
(c) (i) Lemon grass (03)

(ii) Steam distillation (03)

(iii) (i) test : Bromine water (03)
observation : De colourisation (03)

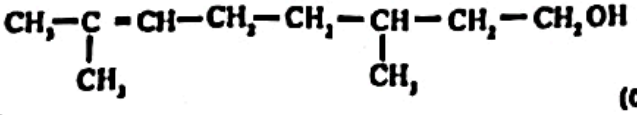
(ii) Aldehyde group (03)
test : 2,4 - DNP / Brady's reagent/ Ammoniacal Silver nitrate / Tollen's reagent (03)
observation : Orange - Red ppt / silver mirror (03)

(iv)



(06)

(v)



(06)

(4) (a)

Reaction occurring - OH ⟶ Cl (03)

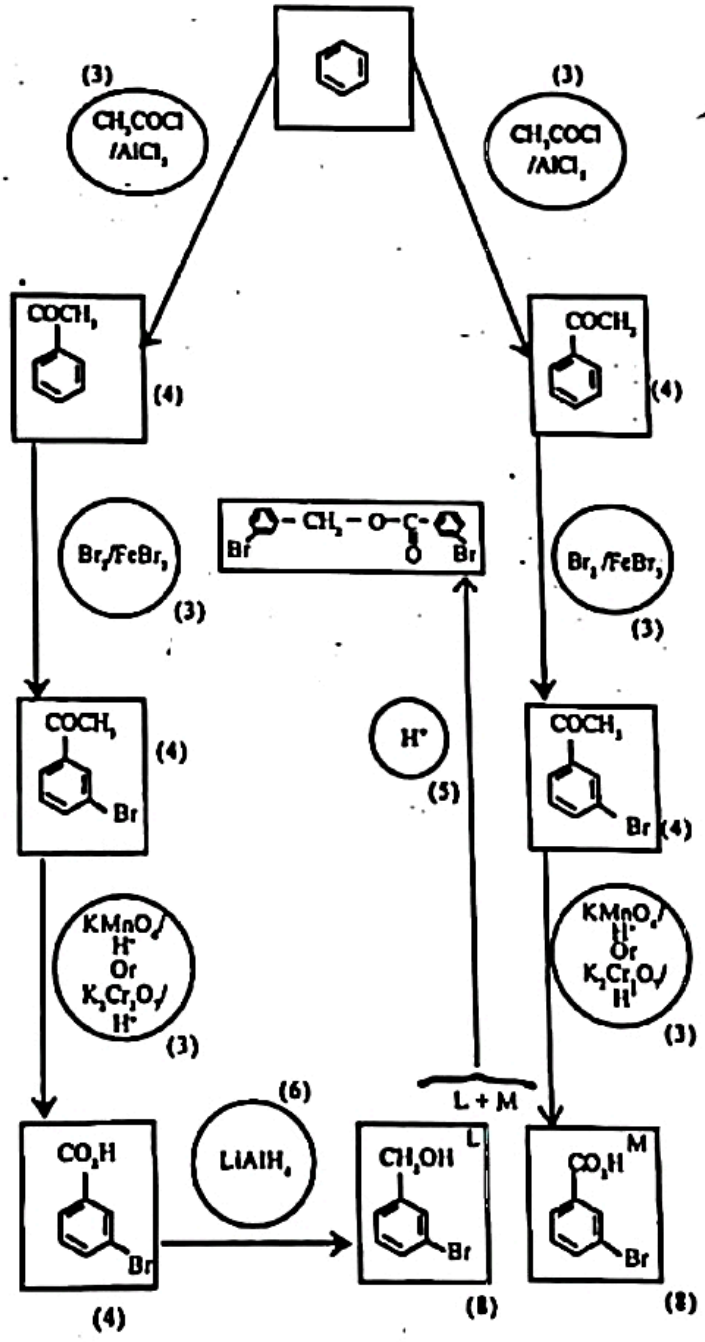
Increase in relative molecular mass = 35.5 - 17
= 18.5 (07)

$C_7H_{10}O_5$ = 150 ; Increase 205.5 - 150
= 55.5 (07)

No. of OH groups = $\frac{55.5}{18.3}$ = 3 (05)

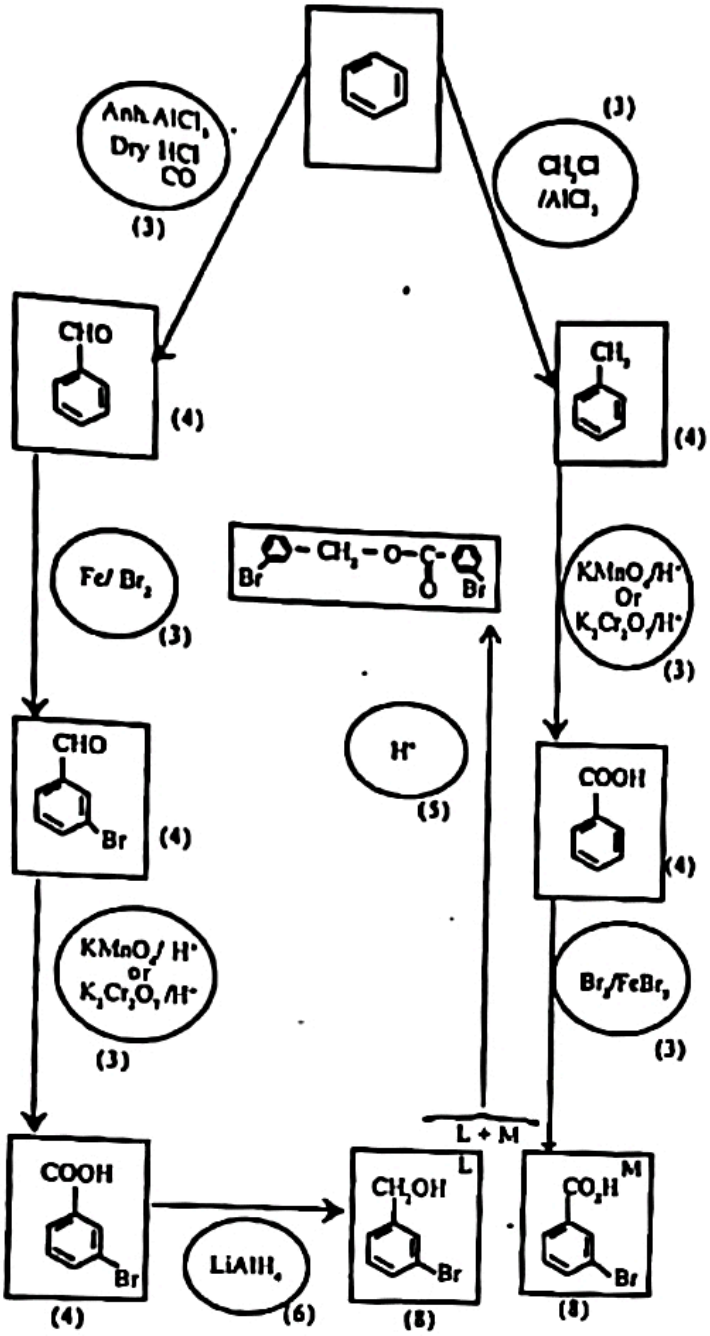
Two of these are CO_2H (1 mole of CO_2 with Na_2CO_3) (08)
No. of hydroxyl groups = 1 (05)
(35)

(b)



(65 Marks)

Alternate Method



(65 Marks)

PART B - ESSAY

Answer two question only. Each question carries 15 marks.

(5) (a) (i)

(i) $Cl_{(g)} + e \rightarrow Cl(g)$

(ii) $Na^+(g) + F^-_{(g)} \rightarrow NaF_{(s)}$

(iii) $H_{2(g)} + \frac{1}{2} O_{2(g)} \rightarrow H_2O_{(l)}$

(iv) $7C_{(s)} + \frac{5}{2} H_{2(g)} + \frac{3}{2} N_{2(g)} + 3O_{2(g)} \rightarrow C_7H_5N_3O_{6(s)}$

(v) $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$

(5 x 6 = 30)

(ii) $-2550 \times 2 = 14\Delta H^\circ_{f\,CO_2} + 2\Delta H^\circ_{f\,TNT}$

$\therefore -5100 = 14\Delta H^\circ_{f,\,CO_2} \cdot 2 - (250)$

$\therefore \Delta H_f^\circ CO_2 = -400\ kJ\ mol^{-1}$

Alternate Method

$14\,C_{(s)} + 5H_{2(g)} + 3N_{2(g)} + 14O_{2(g)} \xrightarrow{-250 \times 2} 2C_7H_5N_3O_{6(s)} + (\quad)$

$14\Delta H^\circ_{f\,CO_2}$; $-2550 \times 2kJ$

$3N_{2(g)} + 5H_{2(g)} + 14CO_{2(g)}$ (4)

$14\Delta H_f^\circ CO_2 = -500 - 5100$

$\therefore \Delta H_f^\circ Co_2 = -400\ kJ\ mol^{-1}$ (

(iii) $C_{(s)} + H_2O_{(g)} \rightarrow CO_{(g)} + H_{2(g)}$ $\Delta H_A^\circ = 125\ kJ$ (A

$CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$ $\Delta H_B^\circ = -800\ kJ$ (

$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ $\Delta H_c^\circ = -400\ kJ$ (

(3 x 5 = 15 mark

(A) x 2 gives

$2C_{(s)} + 2H_2O_{(g)} \rightarrow 2CO_{(g)} + 2H_{2(g)}$

$\Delta H_D^\circ = 250\ kJ$ (D)

(B) + (D) gives

$CH_{4(g)} + 2O_{2(g)} + 2C_{(s)} + 2H_2O_{(g)} \rightarrow CO_{2(g)} + 2CO_{(g)} + 2H_{2(g)} + 2H_2($

$\Delta H_E^\circ = -550\ kJ$ (E)

(C) x 2 gives

$2C_{(s)} + 2O_{2(g)} \rightarrow 2CO_{2(g)}$

$\Delta H_F^\circ = -800\ kJ$ (F)

(E) - (F) gives

$CH_{4(g)} + CO_{2(g)} + 2H_2O_{(g)} \rightarrow 2CO_{(g)} + 2H_{2(g)} + 2H_2O_{(l)}$

$\Delta H^\circ = 250\ kJ$ (G)

If $2H_2O_{(g)} \rightarrow 2H_2O_{(l)}$

$\Delta H^\circ = yKJ$ (H)

$X = (250 + y)\ kJ$

(10 marks)

Total (25 marks

(iv) In constrast to the coal combustion process.

(i) The two reactions in (iii) & (iv) are part of a cycli process; no new starting materials are required.

(ii) Environmental contamination / pollution is minimal sinc the process is cyclic.

(iii) The source of energy (sunlight) is a renewable form o energy available free of charge.

(2 x 10 = 20 marks)

(i) $-850 \times 2 = 7\Delta H^{\circ}_{f\,CO_2} + 5\Delta H^{\circ}_{f\,H_2O} - 2\Delta H^{\circ}_{f\,exp}$ (5)

$-1700 = -7\Delta H^{\circ}_{f\,CO_2} + 5(-300) - 2(-250)$

$7\ \Delta H_{f\,CO_2} = -1700 + 1500 - 500$

$\Delta H^{\circ}_{f\,CO_2} = \frac{-700}{7} = -100\ kJ\ mol^{-1}$ (8)

$2C_3H_5N_3O_{9(l)} \xrightarrow{-2 \times 850\ kJ} 3N_{2(g)} + 7C_{(s)} + 7CO_{2(g)} + 5H_2O_{(l)}$

$-2 \times 250\ kJ$ ↑ ↑ $5 \times -300 + 7\Delta H^{\circ}_{f\,CO_2}$

$14C_{(s)} + 5H_{2(g)} + 3N_{2(g)} + 6O_{2(g)}$ (5)

$7\Delta H^{\circ}_{f\,CO_2} - 1500 = -500 + 2 \times -850$

$\Delta H^{\circ}_{f\,CO_2} = -100\ kJ\ mol^{-1}$ (8)

(5) (b)

(i) Experiment A

Total no. of moles at $t = 5s = \frac{1.012 \times 10^5 \times 8.314 \times 10^{-3}}{8.314 \times 400}$ (2)

$= 0.253$ mol (4)

Say the amount of $N_2O_5(g)$ reacted is x mol.

$2N_2O_{5(g)} \rightarrow 4NO_{2(g)} + O_{2(g)}$

$(0.125 - x)$ mol $+ 2x$ mol $+ \frac{x}{2}$ mol $+ 0.125$ mol $= 0.253$ mol (2)

$\therefore x = 0.002$ (3)

Experiment B

Total no. of moles at $t = 5s = \frac{1.524 \times 10^5 \times 8.314 \times 10^{-3}}{8.314 \times 400}$

$= 0.381$ mol (4)

Say the amount of $N_2O_5(g)$ reacted is y mol.

$(0.250 - y)$mol $+ 2y$mol $+ \frac{y}{2}$ mol $+ 0.125$ mol $= 0.381$ mol (2)

$\therefore y = 0.004$ (3)

(ii). Rate $\alpha\ [N_2O_5]^n$ (2)

For a fixed volum system and a fixed duration of reaction. (2)

Either rate α amount reacted

OR

amount reacted $= K[N_2O_5]^n$ (2)

For A,

(A) 0.002 mol $= k[0.125\ mol / 8.314\ dm^3]^n$

For B,

(B) 0.004 mol $= k[0.250 mol/8.314\ dm^3]^n$ } 2 marks for either A or B

$\frac{(B)}{(A)}$

$\therefore 2 = 2^n$ (4)

$\therefore n = 1$ (4)

Assumptions :

I Gages behave ideally (1)

II The averge rate over 5s corrosponds to the initial concentration of N_2O_5 (g) (3)

(ii) (a) $P = CRT$

(b) Increasein P increases C

(c) As C increases the average distance between molecules decreases OR (the number of collisions increases)

(d) The number of collisions in the favourable orientation increases.

(e) $\therefore$ The rate of the reaction increases

$\frac{(5 \times 2 = 10)}{50}$

(6) (a) Reduction reactions

(i) $Cu^{2+}_{(aq)} + 2e \rightarrow Cu_{(s)}$ (5)

(ii) $2H_2O_{(l)} + 2e \rightarrow H_2(g) + 2OH^-_{(aq)}$ (5)

OR

$2H^+_{(aq)} + 2e \rightarrow H_2(g)$

The above reactions occur at the cathode. (5)

(iii) $2H_2O_{(l)} + O_{2(g)} + 4e \rightarrow 4OH^-_{(aq)}$ (3 bonus marks)

(iv) $Cu^{2+}(aq) + e \rightarrow Cu^+_{(aq)}$ (3 bonus marks)

OR

$Cu^+_{(aq)} + e \rightarrow Cu_{(s)}$

Oxidation Reactions

(i) $2Cl^-_{(aq)} \rightarrow Cl_2(g) + 2e$ (5)

(ii) $2H_2O_{(l)} \rightarrow O_{2(g)} + 4H^+_{(aq)} + 4e$

OR (5)

$4OH^-_{(aq)} \rightarrow 2H_2O_{(l)} + O_{2(g)} + 4e$

The above reactions occur at the anode. (5)

(30)

(b) (i) $K_c = \frac{[SO_{3(aq)}]}{[SO_{3(g)}]}$ (02)

(α) $SO_{3(aq)} \rightleftharpoons H^+_{(aq)} + HSO^-_{3(aq)}$ (02)

(β) $HSO^-_{3(aq)} \rightleftharpoons H^+_{(aq)} + SO^{2-}_{3(aq)}$ (02)

(γ) $H_2O \rightleftharpoons H^+_{(aq)} + OH^-_{(aq)}$ (02)

(α) $K_c = \frac{[H^+_{(aq)}][HSO^-_{3(aq)}]}{[SO_{3(aq)}]}$ (02)

(β) $K_c = \frac{[H^+_{(aq)}][SO^{2-}_{3(aq)}]}{[HSO^-_{3(aq)}]}$ (02)

6) $K_c = \frac{[H^+_{aq}][OH^-_{aq}]}{[H_2O_{(l)}]}$ (2)

(ii) Due to equation (α), PH of SO_2 (aq) is less than that of pure water OR SO_2 (aq) is more acidic compared to pure water. (2)

On aeration SO_2 (g) is carried away. (2)

Accordingly equilibrium between SO_2(aq) & SO_2 is shifted to left. (2)

As $[SO_{2\,(aq)}]$ decreases the equation (α) is also shifted to left. (2)

$[H^+_{(aq)}]$ decreases (2)

equation (β) negligible. (2)

∴ PH increases on aeration. (2)

(14)

(iii) I. Addition of HCl/HNO_3 / named acid will drive equilibrium (α) tothe left.

∴ $[SO_2]$ increases. (3+3)

II. Addition of NaOH/$Ca(OH)_2$/ base will remove H^+(aq). This drive equilibrium (α) to right.

Thus $[SO_2$(aq)] decreases (3+3)

(12)

(c) (i) $K_p = \frac{P_B P_D}{P_A}$ (3)

$K_c = \frac{C_B C_D}{C_A}$ (3)

Since P = CRT (2)

$K_p = \frac{C_B C_D}{C_A} RT = K_c RT$ (4)

R - Gas constant (1)

T - Kelvin Temperature (1)

Assumption - Ideal gas behaviour. (1)

(15)

(ii) No. of moles of A reacted = 2 - 0.5
= 1.5 (2)

∴ $n_A = 0.5$ $n_D = n_B = 1.5$ $n_{He} = 6.5$ (4)

∴ $n_{total} = 10$

$X_A = 0.05$ $X_B = 0.15$ $X_D = 0.15$ (3)

$K_p = \frac{0.15 \times 0.15}{0.05} \times 10^5$ (2)

$= 4.5 \times 10^4$ Pa (3 + 2)

$K_c = \frac{K_p}{RT}$

$= \frac{4.5 \times 10^4 \times 10^3}{8.314 \times 300}$

$= 1.8 \times 10^4$

(iii) $\frac{3.5 \times 10^4}{4.9 \times 10^4} = \frac{6.5}{n_{total}}$ (1)

∴ $n_{total} = 9.1$ (1)

If $y = n_A$ = (reacted)

$2 - y + y + y = 2 + y = 9.1 - 6.5 = 2.6$ (2)

∴ $y = 0.6$ (2)

$n_A = 1.4$ $n_D = 0.6$ $n_B = 0.6$ (3)

$X_A = \frac{1.4}{9.1}$ $X_B = \frac{0.6}{9.1}$ $X_D = \frac{0.6}{9.1}$ (1)

$K_p = \frac{0.6 \times 0.6}{9.1 \times 1.4} \times 4.9 \times 10^4$ (2)

1.38×10^3 Pa (5 + 2)

(25)

(iv) $K_{p\,(17°C)} < K_{p\,(27°C)}$ (2)

(1.38×10^3) (4.5×10^4) (3)

∴ Endothermic (5)

(v) Volume initially increases as D is increased (2)

Then This volume decreases (3)

(5)

B reacts forming A as equilibrium is reached according to LC principle (3)

Finally reaches a constant volume at equilibrium (2)

(10)

7) (a) (i) Solubility product of AgCl = $[Ag^+_{(aq)}][Cl^-_{aq}]$ (5)

Minimum concentration of $[Ag^+]$ required for AgCl precipitaion = $\frac{1 \times 10^{-10}}{0.01}$ (2)

$= 10^{-8}$ mol dm^{-3}

(3 + 2)

Solubility product of Ag_2CrO_4 = $[Ag^+_{(aq)}]^2 [CrO^{2-}_{4\,(aq)}]$

(5)

Minimum concentration $[Ag^+]$ required in the solution for Ag_2CrO_4 to just precipitate

$= \left[\frac{1 \times 10^{-12}}{0.01}\right]^{\frac{1}{2}}$ (2)

$= 10^{-5}$ mol dm^{-3} (3 + 2)

∴ AgCl will be precipatated first (10)

(ii) Concentration of Cl^- in the solution when Ag_2CrO_4 just begins to precipitate

$= \frac{1 \times 10^{-10}}{10^{-5}}$ (4)

$= 10^{-5}$ mol dm^{-3} (4 + 2)

(iii) Assumption

Addition of $AgNO_3$ solution does not increase the volume of the halide solution (6)

(50)

(b) (i) pH = 3.21

pH = $-\log C_{H^+}$ (4)

C_{H^+} = 0.0006165 mol dm^{-3} (5)

$K_A = 1 \times 10^{-3} = \frac{(0.000616)^2}{(HA)_{eq}} = 0.03802$ (2)

$[HA]_{eq} = \frac{(0.000616)^2}{10^{-3}} = 0.03802$ (2)

$[HA_{CHCl_3}] = 0.057 - 0.038 = 0.019$ (2)

$K = \frac{0.038}{0.019} = 2$ (4)

(19)

(ii) 500 cm^3 0.027 mol dm^{-3} NaOH contains $\frac{0.027}{2}$ mol NaOH (2)

This reacts with $\frac{0.027}{2}$ mol of HA to give $\frac{0.027}{2}$ mol of NaA (4)

∴ Concentration of HA left $= \left[\frac{0.057}{2} - \frac{0.027}{2}\right] \times 2$ (2)

$= 0.030$ (2)

Concentration of NaA $= 0.027$ (2)

If HA in $CHCl_3$ is Y (2)

$K = 2 = \frac{0.03 - Y}{Y}$ (2)

$\therefore Y = 0.01$ mol dm^{-3} (4 + 2)

$\therefore [HA_{eq}] = 0.03 - 0.01 = 0.02$ (2)

$\therefore 10^{-3} = \frac{[H^+][A^-]}{0.02} = \frac{[H^+][NaA]}{0.02}$ (2 + 2)

$\therefore [H^+] = 7.406 \times 10^{-4}$ mol dm^{-3} (3 + 2)

$\therefore$ PH = 5.13 (8)

(41)

(iii) Asumptions

I. Concentration of dissociated HA small compared to undissociated (2)

II. Concentration of A^- is equal to concentration of NaA (2)

(iv) (a) Make aq solution basic/ acidic

(b) Amine present as free amine / (salt) and acid present as salt / (free acid)

(c) extract base / (acid) with $CHCl_3$

(d) evaporate $CHCl_3$ to obtain solid base / (acid)

(e) Make remaining aqueous solution / (fresh) portion of aqueous solution acidic / (basic)

(f) Amine present as salt / (free amine) and acid present as free acid/ (salt)

(g) extract with $CHCl_3$

(h) evaporation $CHCl_3$ to obtain solid acid / (base)

(2 marks x 8 = 16)

(20)

(c) Dissolution of O_2 in water is an exothermic process (5)

∴ Greater solubility at lower temperatures (5)

∴ Artic stream contains more oxygen (5)

This is released when the stream reaches warmer climates (5)

(20)

PART C - ESSAY

(8) (a) (i) d - block (7)

(ii) V (7)

(iii) $1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 4S^2\ 3d^3$ or $3d^3\ 4S^2$ (7)

(iv) V_2O_5 (7)

(v) As a catalyst in the Contact Process (CH_2SO_4 Preparation) OR as a catalyst for the conversion of SO_2 to SO_3

OR

$SO_2 + \text{air } (O_2) \xrightarrow[\Delta]{V_2O_5} SO_3$ (7)

(vi) +2, +3, +4 (7)

(42)

(b) (i) The compound that gives the smell of ammonia OR decomposes without leaving a residue is $(NH_4)_2CO_3$ (5)

The compound that turns black / silvery is Ag_2CO_3 (5)

The compound that does not undergo any change is Na_2CO_3 (5)

(ii) Solutions that do not form a ppt when mixed are dil HCl & dil H_2SO_4.

∴ The other is $Pb(NO_3)_2$

The ppt that disloves on heating is $PbCl_2$ which is formed when dil HCl and $Pb(NO_3)_2$ are mixed.

The ppt formed when dil H_2SO_4 and $Pb(NO_3)_2$ are mixed does not disolve when heated

(5 x 3)

(iii) The solution that turns the blue Litmus paper red is $(NH_4)_2SO_4$. This red litmus paper is then dipped into the other two solutions. That which turns it back to blue is $Ca(OH)_2$. The other is CH_3COONH_4

(5 x 3)

(iv) The solutions that do not produce a ppt when mixed are $Na_2S_2O_3$ solutions.

The other is the dil HCl solutions.

0.5 M $Na_2S_2O_3$ solution gives a ppt quickly with 0.5 M HCl.

0.1 M $Na_2S_2O_3$ solution take a longer time

(5 x 3)

(60)

(c) (i) $2H_2O_2 \rightarrow 2H_2O + O_2$ (4)

(-1) (-2) (0) (2 x 3 = 6)

(ii) $Sn^{2+} \rightarrow Sn^{4+} + 2e$ (3)

$H_2O_2 + 2H^+ + 2e \rightarrow 2H_2O$ (5)

(iii) $Ag_2O + 2H^+ + 2e \rightarrow 2Ag + H_2O$ (5)

$H_2O_2 \rightarrow O_2 + 2H^+ + 2e$ (5)

(iv) Amount of H_2O_2 in 100 cm^3 of

0.1 mol dm^{-3} $H_2O_2 = \frac{0.1 \times 100}{1000}$ (3)

= 0.01 mol

Amount of Sn^{2+} in 50 cm^3 of 0.1 mol dm^{-3}

Sn^{2+} solution = $\frac{0.1 \times 50}{1000}$

= 0.005 mol (03)

1 mol of H_2O_2 reacts with 1 mol of Sn^{2+} (2)

∴ The amount of reacted with Sn^{2+} = 0.005 mol (2)

∴ The amount of H_2O_2 remaining = 0.005 mol (2)

1 mol H_2O_2 evolves 1 mol of O_2 (2)

∴ The amount of O_2 evolved = 0.005 (6)

(48)

') (a) (i) Electrolysis of Sea water using the diaphragm cell (1 + 1)

Gives Cl_2 gas, H_2 gas and NaOH (2 x 3)

Cathode - Fe anode C or Ti (1 + 1)

Pas Cl_2 gas to bittern (2)

Br_2 liberated (or $Cl_2 + 2Br \rightarrow 2Cl^- + Br_2$) (3)

NaOH concentrated (2)

Br_2 made to react with hot conc NaOH (3)

$Br_2 + 6NaOH \rightarrow 5NaBr + NaBrO_3 + 3H_2O$

$NaBrO_3$ Isolated by fractional crystallization

(ii) Chemicals produced in the process

NaOH, Cl_2, H_2, Nacl, NaBr, $NaBrO_3$, Br_2

NaOH - Manufacture of Soap, paper industry, drugs, detergents

Cl_2 - Sterilize water for drinking purposes Bleaching powder manuacture

H_2 - Synthesis of NH_3, hydrogenation of fats

NaCl - Manufacture of table salt, salting out in soap industry, manufacture of Na

NaBr - Optical components (IR)

$NaBrO_3$ - Oxdizing agent, flour additive antifungal agent

Br_2 - Photography industry, manufacture of drugs, to prepare ethylene dibromide.

(4 marks x 3 = 1

(iii) Environmental

(a) Climate (temp, less rain, more sunshine)

(b) Away from builtup areas

(c) halogens are toxic

(3 marks x 2 =(

Economic

(a) Cheap power

(b) transport

(c) availability of labour

(d) demand for the product

(e) cheap raw materials

(f) Use of by products

(g) Proximity to sea (3 marks x 2 =(

Total for 9 (a) (5

(b) (i) Mixture does not contain Group I and Group II cations. (5 + 5

(ii) Precipitate contains any one or more of the Group III hydroxides (5+5

(iii) I_2 Liberated

Precipiate contains Fe^{+3} (5

(iv) White precipitate is any one of the carbonates.

$CaCO_3$, $SrCO_3$, $BaCO_3$ or $ZnCO_3$ (2x4 = 8

(v) Yellow precipitate is $BaCrO_4$ (7

Thus elements A & B are Fe and Ba (5 +5

(8

(c) (i) $Mg(HCO_3)_2$, $Ca(HCO_3)_2$ (3 marks x 2 = 6)

(ii) $CaSO_4$, $MgCl_2$ (3 marks x 2 = 6)

(iii) form deposits / scales in kettles
form in soluble soaps / scum with soap
makes washin difficult. gives unpleasent taste
(3 marks x 2 = 6)
(18)

(iv)(A) $HCO_3^- + HCl \rightarrow CO_2 + H_2O + Cl^-$
OR
$HCO_3^- + H^+ \rightarrow CO_2 + H_2O$
OR
$M(HCO_3)_2 + 2HCl \rightarrow MCl_2 + 2CO_2 + 2H_2O$
(M = Ca, Mg) (2)

Amount of HCl used in the neutralization
$= \frac{0.02}{1000} \times 16$
$= 0.00032$ (2)

∴ The amount of HCO_3^- in 100 cm^3 of the water sample = 0.00032 (2)

Hence the amount of Mg^{2+} and Ca^{2+} responsible for the temporary hardness in 100.0 cm^3 of the water sample
$= \frac{0.00032}{2}$
$= 0.00016$ (2)

∴ Concentration of Ca^{2+} and Mg^{2+} responsible for temporary hardness in the water sample
$= \frac{0.00016}{100} \times 1000$
$= 0.0016$ mol dm^{-3} (2)

Thus the temporary hardness of the water sample
$= 0.0016 \times 100 \times 10^3$
$= 160$ (2)
(12)

(B) $CaSO_4 + Na_2CO_3 \rightarrow CaCO_3 \downarrow + Na_2SO_4$ (2)

$MgCl_2 + Na_2CO_3 \rightarrow MgCO_3 \downarrow + 2NaCl$ (2)

$Na_2CO_3 + 2HCl \rightarrow 2NaCl + CO_2 + H_2O$ (2)

HCl required for the neutralization $= \frac{14}{1000} \times 0.02$
$= 0.00028$ (2)

∴ Amount of Na_2CO_3 in 50 Cm^3 of the sample
$= \frac{0.00028}{2}$
$= 0.00014$ (2)

Amount of Na_2CO_3 in 250 Cm^3 of the sample
$= 0.00014 \times 5$
$= 0.0007$ (2)

Amount of Na_2CO_3 added to the water sample
$= \frac{18}{111} \times 0.05$
$= 0.0009$ (2)

∴ Amount of Na_2CO_3 combined with $CaSO_4$ and $MgCl_2$ which are responsible for permanent hardness
$= 0.0009 - 0.0007$
$= 0.0002$ (2)

Hence the concentration of $CaSO_4$ and $MgCl_2$ in the water sample $= 0.0002 \times \frac{1000}{200}$
$= 0.001$ mol dm^{-3} (2)

Thus the permanent hardness of the water sample
$= 0.001 \times 100 \times 10^3$
$= 100$ (2)
(20)

Total for 9 (c) = (50)

(10) (a) (i)
Fe_2O_3	-	haematite	
$FeCO_3$	-	siderite	
Fe_3O_4	-	magnetite	any two
FeS_2	-	iron pyrites	(5 x 2 = 10)

(ii) Coke (C), Limestone $CaCO_3$ (3 x 2 = 6)

(iii) Coke ; to produce CO/ acting as a reducing agent also produces heat to raise the temperature of the blast furnace limestone : to give the slag
(2 x 3 = 6)

(iv) Coke, CO (2 x 2 = 4)

(v) up to 1000 °C (< 1000 °C)

$3Fe_2O_3 + CO \rightarrow 2Fe_3O_4 + CO_2$

$Fe_3O_4 + CO \rightarrow 3FeO + CO_2$

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

$FeO + CO \rightarrow Fe + CO_2$

$CaCO_3 \rightarrow CaO + CO_2$

above 1000 °C (> 1000 °C)

$CaO + SiO_2 \rightarrow CaSiO_3$

$SiO_2 + 2C \rightarrow Si + 2CO$

$CaO + Al_2O_3 \rightarrow Ca(AlO_2)_2$

$C + CO_2 \rightarrow 2CO$

$FeO + C \rightarrow Fe + CO$

any 7 reactions 7 x 2 = 14
Correct appropriate temperature 2 x 1 = 2

(v) CO, CO_2 emission, SO_2 emission heat, dust / slag

$(2 \times 3 = 6)$

$10 (a) = (\overline{16})$ marks

(b) (i) phenol formaldehyde polymer or (bakelite)
poly isoprene or rubber
poly tetrafluoroethylene - or teflon
poly ethylene glycolterephalate or terylene

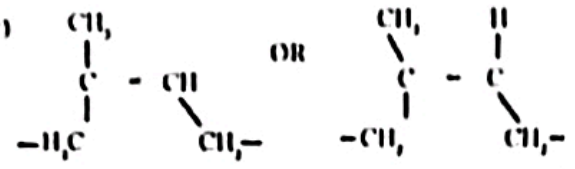
$(4 \times 4 = 16)$

(ii) bake lite - switches, electrical (non conducting) component, insulators
rubber - tyres, tubes
teflon - (nonstick) kitchen ware
terylene - fibre (textile) $(4 \times 4 = 16)$

(iii) $-CF_2-(CF_2-CF_2)_n-CF_2$ OR $-CF_2-CF_2-$

(7)

(iv)



(7)

(v) phenol - formaldehyde (bakelite) (4)

(50)

(C) $2CrO_4^{2-} + 16H^+ + 6I^- \longrightarrow 2Cr^{3+} + 8H_2O + 3I_2$ (6)

OR

$Cr_2O_7^{2-} + 14H^+ + 6I^- \longrightarrow 3I_2 + 2Cr^{3+} + 7H_2O$

$I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$ (6)

No. of moles of $S_2O_3^{2-}$ = $0.1 \times 10^{-3} \times 30.0$
= 3.0×10^{-3} (4)

No. of moles of I_2 liberated = $\frac{1}{2} \times 3.0 \times 10^{-3}$
= 1.5×10^{-3} (4)

No. of moles of CrO_4^{2-} = $\frac{1}{2} \times 3.0 \times 10^{-3} \times \frac{2}{3}$
= 1.0×10^{-3} (4)

Concentration of CrO_4^{2-} = $1.0 \times 10^{-3} \times \frac{1000}{25}$
= 0.04 mol dm^{-3} (6 + 2)

$\therefore$ Mass of $PbCrO_4$ ppt = $1.0 \times 10^{-3} \times 323$ g
= 0.323g (4)

$\therefore$ Mass of $PbSO_4$ = 0.929 - 0.323 g (4)

No of moles of $PbSO_4$ = $\frac{0.929}{303}$ =
= 3×10^{-3}

no of moles of SO_4^{2-} = 3×10^{-3}

Concentration of SO_4^{2-} = 3×10^{-3} x
= 0.08 mol

If $Cr_2O_7^{2-}$ is used in the calculation, then
number of moles of $Cr_2O_7^{2-}$ = $1.5 \times 10^{-3} \times \frac{1}{3}$

Hence the number of moles of $Cr_2O_7^{2-}$
= $1.5 \times 10^{-3} \times \frac{2}{3}$