G.C.E. (A/L) Examination
Chemistry - 2004

M.C.Q. Answers

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

PART A - STRUCTURED ESSAY

Each question carries a maximum of 100 marks out of 1000.

(01) (a) (i) N,P (ii) H (iii) N, Cl, Cr (iv) Zn
(v) O (vi) O, S, P (vii) Cl, S (2 x 13 = 26)

(b) (i) X = Li, Na (5 x 2) Y = Al, Be (5 x 2) Z = H_2 (5)

(ii) White precipitate (5)
redissolves in excess

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M.C.Q. Answers

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

PART A - STRUCTURED ESSAY

Each question carries a maximum of 100 marks out of 1000.

(01) (a) (i) N.P (ii) H (iii) N, Cl, Cr (iv) Zn

(v) O (vi) O. S. P (vii) Cl, S (2 x 13 = 26)

(b) (i) X = Li. Na (5 x 2) Y = Al. Be (5 x 2) Z = H_2 (5)

(ii) White precipitate (5)

redissolves in excess. (5)

(iii) $2OH^- + 2Al + 2H_2O \rightarrow 2AlO_2^- + 3H_2$ (9)

OR $2NaOH + 2Al + 2H_2O \rightarrow 2NaAlO_2 + 3H_2$

OR $2LiOH + 2Al + 2H_2O \rightarrow 2LiAlO_2 + 3H_2$

OR $2OH^- + Be \rightarrow BeO_2^{2-} + H_2$

OR $2NaOH + Be \rightarrow Na_2BeO_2 + H_2$

OR $2LiOH + Be \rightarrow Li_2BeO_2 + H_2$

(44 marks)

(c) L= SO_2 M = SO_3 N = H_2SO_4

(10 marks) (10 marks) (10 marks)

(Total = 100 marks)

(02) (a) (i) $4CrO_3 \rightarrow 2Cr_2O_3 + 3O_2$ (10)

Mass of 1 mol of CrO_3 = 100 g (2)

Mass of 1 mol of O_2 = 32 g

OR Mass of 1 mol of Cr_2O_3 = 152 g (2)

Mass of CrO_3 = 0.34g (6)

Methods of finding the mass of CrO_3 (10)

% mass of CrO_3 in the mixture = $\frac{0.34g}{0.4g}$ x 100 (4)

= 85 (6)

(40 marks)

There are several methods of finding the mass of CrO_3.

(A) When 400g of CrO_3 decomposes the loss of mass = 96 g

Loss of mass = 0.4000 g - 0.3148 g = 0.0816 g

Mass of CrO_3 in the sample = $\frac{400g}{96g}$ x 0.0816g

= 0.34 g

(B) Let mass of CrO_3 in 0.4000 g of sample be x

$$\frac{x}{100g \times 2} \times 152g + (0.4000g - x) = 0.3184 g$$

x = 0.34 g

(C) Let the mass of Cr_2O_3 in 0.4000 g of sample be x

$$\therefore \frac{(0.4000 g - x)}{100 g \times 2} \times 152 g + x = 0.3184 g$$

$\therefore x = 0.06 g$

Thus mass of CrO_3 in the sample = 0.4000 g - 0.06 g
= 0.34 g

(iii) $Cr_2O_3 + 10 OH^- \rightarrow 2CrO_4^{2-} + 5H_2O + 6e$ (10)

(b) (i) To measure the time taken (4)
(EITHER) to remove a given / same/ constant amount of I_2 formed during the reaction
(OR) for the formation of a given / same/ constant amount of I_2.
(OR) for the reaction of a given/ same/ constant amount of I^-/ Fe^{3+} (6)

(ii) To indicate the presence of free I_2 in the reaction mixture (5) OR to indicate I_2 formed after all the $Na_2S_2O_3$ is consumed.

(iii)

Group	
A	The reaction between H^+ and $S_2O_3^{2-}$ giving S, therefore the amount of $S_2O_3^{2-}$ available to react with I_2 varies OR The reaction between Fe3+ and $S_2O_3^{2-}$ giving S, therefore the concentrations are not what they are expected to be . (8 marks)
B	The reaction starts as soon as Fe^{3+} and KI are mixed much before stop watch is started OR the reaction starts before the contents of the beakers are mixed. (8 marks)
C	Correct (4)

(iv) (α) Decrease the concentration / amount of Fe^{3+}/KI (5 marks)

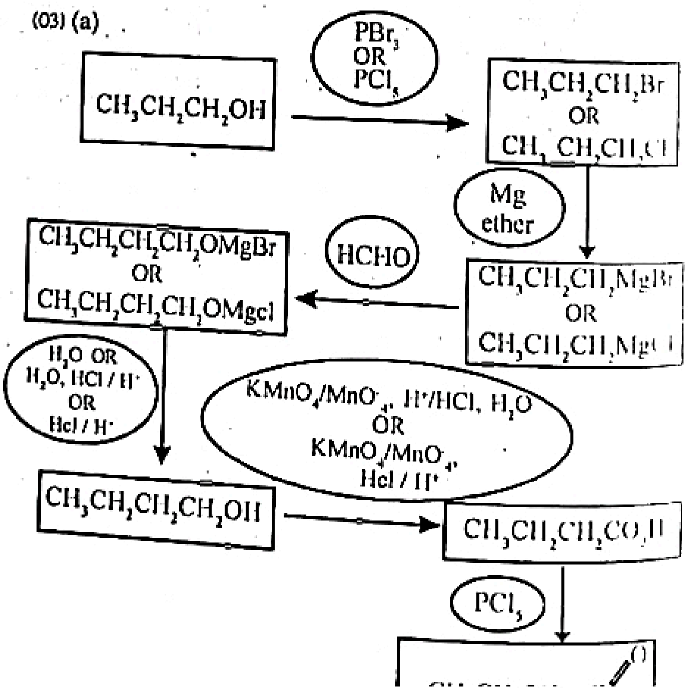
(β) Increase the concentration /amount of $S_2O_3^{2-}$ (5 marks)

(γ) Decrease the temperature (5 marks)

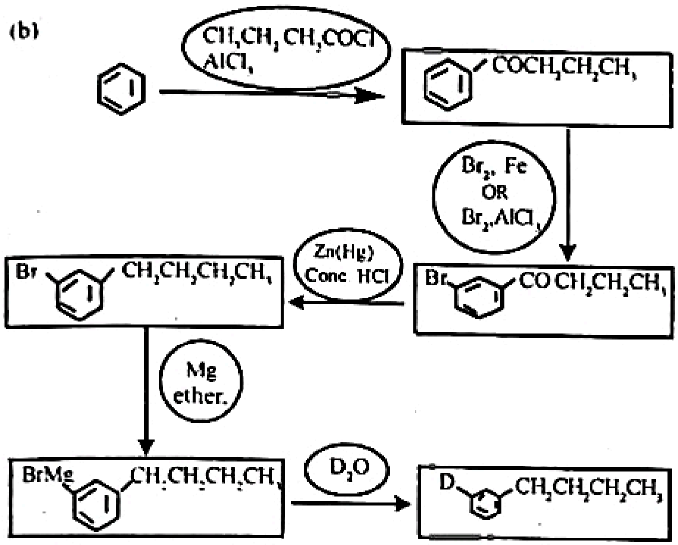
(50 marks)

Total = 100 marks

(03) (a)



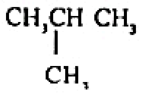
(b)



5 x 9 = 45 marks
(3) total = 100 marks

(04)(a) (i) C_4H_{10}

(ii) $CH_3CH_2CH_2CH_3$


$CH_3\underset{\displaystyle CH_3}{\underset{|}{CH}}CH_3$

(iii) $CH_3CH_2CH_2CH_3$

(iv) $\boxed{CH_2 = CH - CH = CH_2}$ $\boxed{CH_3 - C \equiv C - CH_3}$

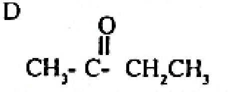
$\boxed{CH_3CH_2C \equiv CH}$ $\boxed{CH_2 = C = CH\,CH_3}$

(v) $\boxed{CH_3CH_2\,C \equiv CH}$

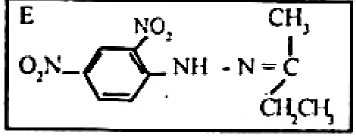
C

$CH_3C \equiv C\,CH_3$

D

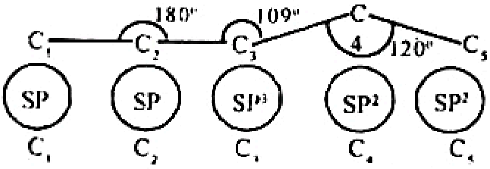

$CH_3-\overset{\displaystyle O}{\overset{\|}{C}}-CH_2CH_3$

E



(4 x 12 = 48 marks)

(b) (i)



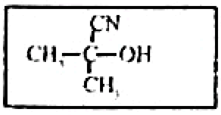
(2 x 5 = 10 marks)

(ii) C_5H_8

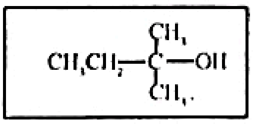
(6 marks)

(b)-16 marks

(c) (i)


$CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CN}{C}}-OH$

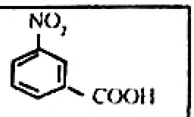
A


$CH_3CH_2-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{C}}-OH$

B


$CH_3\overset{\displaystyle Br}{\overset{|}{C}H}CH_2Br$

C



D

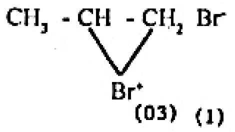
(4 x 4 = 16 marks)

(ii)

Mechanism - type	Reaction No.	Electrophile	Nucleophile
Electrophilic addition .	III	Br^+	▨
Electrophilic substitution	IV	NO_2^+	▨
Nucleophilic addition	I	▨	CN^-
Nucleophilic substitution	II	▨	OH^-

2 x 8 = 16 marks

(iii)



(03) (1)

(c) 36 marks
(Total = 100 marks)

PART - B (Essay)

Each question carries a maximum of 150 marks out of 1000

(5) (a) In an ideal mixture of gases (or a mixture of gases that do not interact with each other), the total pressure of the mixture is equal to the sum of the partial pressures of the constituent gases (10 marks)

$$d = \frac{m}{v} = \frac{70 \times 70 + 72 \times 20 + 74 \times 10}{V} = 2.36$$

(5) (5)

$$\frac{7080}{2.36} = V = 3000\ dm^3 \qquad (3 + 2)$$

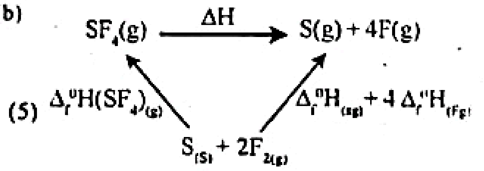
$$P_{Cl_2} = \frac{nRT}{V} = \frac{10 \times 8.314 \times 300}{3000 \times 10^{-3}} = 8.314 \times 10^3\ Pa$$

(3) (7) (5) (5)

($P_a = Nm^{-2}$)

(a = 45 marks)

(b)



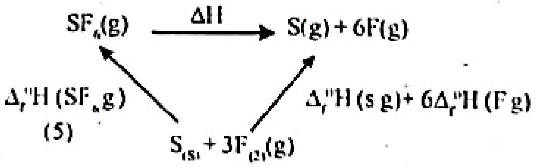
(5) (5)

$-775 + \Delta H = 279 + 4 \times 79 = 279 + 316 = 595$ (5)

$\therefore \Delta H = 1370$

$\Delta H_D\ (S\text{-}F) = \frac{1370}{4}$

$= 342.5\ kJ\ mol^{-1}$ (3 + 2)



(5) (5)

$-1210 + \Delta H = 279 + 6 \times 79$

$= 279 + 474 = 753$ (5)

$\therefore \Delta H = 1963$

$\therefore \Delta_D H(S\text{-}F) = \frac{1963}{6}$

$= 327.1\ kJ\ mol^{-1}$ (5)

S - F bond in SF_4 is stronger than that in SF_6 (5)

(45 marks)

(c) (i) -110 - (-242) = 132 kJ mol (10)

(ii) -395 - 0 = - 395 kJ mol (10)

(5)

Reaction of steam with coal is endothermic

Therefore, temperature of coal drops as the reaction proceeds (5)

The rate of a reaction depends on temperature (5)

The rate of the reaction between steam and coal decreases with time. (5)

As the activation energy of the reaction is high a temperature of about 400°C is required for the reaction to occur at a rate sufficient for industry (5)

The reaction of O_2 (in air) with coal is exothermic (5)

Therefore, when air is passed over coal the temperature of coal can be increased (to above 400°C). (5)

Air is passed alternately with steam in this process to keep the temperature at a sufficiently high value (5)

(60 marks)

Total = 150 marks

(06) (a) Solubility Product = $[M^{3+}_{(aq)}]^2[X^{2-}_{(aq)}]^3$

Note If (aq) is not indicated do not award the 10 marks.

(10 marks)

(b) $K = \dfrac{[Ag(NH_3)_2^+ (aq)]}{[Ag^+(aq)][NH_3(aq)]^2}$ (5)

$1.7 \times 10^7 = \dfrac{0.12}{[Ag^+(aq)] \times (2.0)^2}$ (5)

$\therefore [Ag^+(aq)] = 1.8 \times 10^{-9} mol\,dm^{-3}$ (5)

$1.7 \times 10^7 = \dfrac{0.06}{[Ag^+(aq)] \times (1.0)^2}$ (5)

$[Ag^+(aq)] = 3.5 \times 10^{-9}$ mol dm^{-3} (5)

$k_{sp(AgCl)} = [Ag^+(aq)][Cl^-(aq)]$ (3)

In the solution.

$[Ag^+(aq)][Cl^-(aq)] = 3.5 \times 10^{-11}$ mol² dm^{-6} (7)

This value is less than 1.8×10^{-10} mol² dm^{-6} (5)

AgCl will not precipitate (10)

(50 marks)

Alternate answer to Question 6 (b)

$K = \dfrac{[Ag^+(aq)+ [NH_3(aq]^2}{[Ag[NH_3)^+_2(aq)]}$ (5)

Let x be the concentration of $Ag^+_{(aq)}$

$1.7 \times 10^7 = \dfrac{x(2.0)^2}{0.12 - x}$ (5)

$2.04 \times 10^6 - 1.7 \times 10^7 x = 4x$

$\therefore 2.04 \times 10^6 \simeq 1.7 \times 10^7 x$

$\therefore [Ag^+(aq)] = 0.06 mol\,dm^{-3}$ (5)

$k_{sp}(AgCl) = [Ag^+(aq)][Cl^-(aq)]$ (3)

In the solution,

$[Ag^+(aq)][Cl^-(aq)] = 6 \times 10^{-4}$ mol² dm^{-6} (7)

This value is greater than 1.8×10^{-10} mol² dm^{-6} (5)

AgCl will precipitate (10)

(50 marks)

(c) (i)

$[B]_{aq} = 0.15 \times 10^{-2}$ (5)

$\therefore K = \dfrac{4.5 \times 10^{-2}}{0.15 \times 10^{-2}} = 30$ (5) (5)

(ii) $Z = (x - y)10$ (5)

$30 = \dfrac{(x-y)\,10}{y}$ (5)

$40y = 10x$

and. $\dfrac{y}{x} = \dfrac{1}{4}$

(iii) $x = \dfrac{4 \times 10^{-4} \times 100}{125 \times 100} \times 1000$

$= 3.2 \times 10^{-3} mol.dm^{-3}$

$y = 0.8 \times 10^{-3}$

$= 8.0 \times 10^{-4} mol.dm^{-3}$

$z = (X - Y)10$

$= (3.2 \times 10^{-3} - 0.8 \times 10^{-3})10$

$= 2.4 \times 10^{-2} mol.dm^{-3}$.

(iv) $y = \boxed{\dfrac{x}{4^3}} = \boxed{\dfrac{x}{64}}$

$= \dfrac{3.2 \times 10^{-3}}{64}$

$= 0.05 \times 10^{-3}$

$= 5 \times 10^{-5} mol.dm^{-3}$

$= 5 \times 10^{-5} \times 125 \times 10^{3}$

$= 6.25$ ppm

(90)

Total = 15

(07) (a) No change when A is immersed in a solution of A^{m+} (aq) [i.e. $A_{(s)} / A^{m+}$ (aq)]

No change when B is immersed in a solution of B^{n+}(aq) [i.e. $B_{(s)} / B^{n+}$ (aq)]

Out of the two electrodes $A_{(s)} / B^{n+}$ (aq) and $B_{(s)} / A^{m+}$ (aq) a change/ dissolution of metal Occurs only in one.

The metal that dissolves is the more reducing and the solution contains.

The cation of the other metal

(b) (i) (I) $A(g) = P(g) + Q(g)$

$0.2 - x \quad x \quad x$

Total no. of moles at equilibrium

$= \dfrac{1.2 \times 10^5 \times 8.314 \times 10^{-3}}{8.314 \times 400}$ (4) $= 0.30$ (4)

$0.2 + x = 0.3$ mol

$\therefore x = 0.1$ mol

$\therefore P_A = P_P = P_Q = \dfrac{0.1}{0.3} \times 1.2 \times 10$
(2) (2) (3)

$= 4 \times 10^4$ Pa

$\therefore K_p = \dfrac{4 \times 10^4 \times 4 \times 10^4}{4 \times 10^4}$

$= 4 \times 10^4$ Pa

(II) Total no. of moles at equilibrium

$= \dfrac{1.4 \times 10^5 \times 8.314 \times 10^{-3}}{8.314 \times 400}$ (2) $= 0.35$

$0.4 - x = 0.35$ mol

$x = 0.05$ mol

$P_B = P_D = \dfrac{0.15}{0.35} \times 1.4 \times 10^5$ (2)
(2)

(5)

Reaction of steam with coal is endothermic
Therefore, temperature of coal drops as the reaction proceeds (5)
The rate of a reaction depends on temperature (5)
The rate of the reaction between steam and coal decreases with time (5)
As the activation energy of the reaction is high a temperature of about 400°C is required for the reaction to occur at a rate sufficient for industry (5)
The reaction of O_2 (in air) with coal is exothermic (5)
Therefore, when air is passed over coal the temperature of coal can be increased (to above 400°C). (5)
Air is passed alternately with steam in this process to keep the temperature at a sufficiently high value (5)

(60 marks)
Total = 150 marks

(a) Solubility Product = $[M^{x+}_{(aq)}]^y[X^{y-}_{(aq)}]^x$

Note If (aq) is not indicated do not award the 10 marks.
(10 marks)

(b) $K = \dfrac{[Ag(NH_3)_2^+(aq)]}{[Ag^+(aq)][NH_3(aq)]^2}$ (5)

$1.7 \times 10^7 = \dfrac{0.12}{[Ag^+(aq)] \times (2.0)^2}$ (5)

$[Ag^+(aq)] = 1.8 \times 10^{-9}\ mol\ dm^{-3}$ (5)

$1.7 \times 10^7 = \dfrac{0.06}{[Ag^+(aq)] \times (1.0)^2}$ (5)

$[Ag^+(aq)] = 3.5 \times 10^{-9}\ mol\ dm^{-3}$ (5)

$K_{sp\ AgCl} = [Ag^+(aq)][Cl^-(aq)]$ (3)

In the solution,

$[Ag^+(aq)][Cl^-(aq)] = 3.5 \times 10^{-11}\ mol^2\ dm^{-6}$ (7)

This value is less than $1.8 \times 10^{-10}\ mol^2\ dm^{-6}$ (5)
AgCl will not precipitate (10)

(50 marks)

Alternate answer to Question 6 (b)

$K = \dfrac{[Ag^+(aq)][NH_3(aq)]^2}{[Ag(NH_3)_2^+(aq)]}$ (5)

Let x be the concentration of $Ag^+_{(aq)}$

$1.7 \times 10^7 = \dfrac{x(2.0)^2}{0.12 - x}$ (5)

$2.04 \times 10^6 - 1.7 \times 10^7 x = 4x$

$2.04 \times 10^6 = 1.7 \times 10^7 x$

$[Ag^+(aq)] = 0.06\ mol\ dm^{-3}$ (5)

$K_{sp}(AgCl) = [Ag^+(aq)][Cl^-(aq)]$ (3)

In the solution

$[Ag^+(aq)][Cl^-(aq)] = 6 \times 10^{-4}\ mol^2\ dm^{-6}$ (7)

This value is greater than $1.8 \times 10^{-10}\ mol^2\ dm^{-6}$ (5)
AgCl will precipitate (10)

(50 marks)

(c) (i)

$[B]_{aq} = 0.15 \times 10^{-3}$ (5)

$K = \dfrac{4.5 \times 10^{-3}}{0.15 \times 10^{-3}} = 30$ (5) (5)

(ii) $Z = (x - y)10$ (5)

$30 = \dfrac{(x-y)10}{y}$ (5)

$40y = 10x$ (5)

and $\dfrac{y}{x} = \dfrac{1}{4}$ (5)

(iii) $x = \dfrac{4 \times 10^{-4} \times 100}{125 \times 100} \times 1000$

$= 3.2 \times 10^{-3}\ mol.dm^{-3}$ (5)

$y = 0.8 \times 10^{-3}$
$= 8.0 \times 10^{-4}\ mol.dm^{-3}$ (5)

$z = (X - Y)10$
$= (3.2 \times 10^{-3} - 0.8 \times 10^{-3})10$ (5)
$= 2.4 \times 10^{-2}\ mol.dm^{-3}$. (5)

(iv) $y = \left[\dfrac{x}{4^3}\right] = \left[\dfrac{x}{64}\right]$ (10)

$= \dfrac{3.2 \times 10^{-3}}{64}$
$= 0.05 \times 10^{-3}$
$= 5 \times 10^{-5}\ mol.dm^{-3}$ (10)
$= 5 \times 10^{-5} \times 125 \times 10^{3}$ (5)
$= 6.25$ ppm (10)

(90 marks)
Total = 150 marks

(07) (a) No change when A is immersed in a solution of A^{m+} (aq) [i.e. $A_{(s)} / A^{m+}(aq)$] (10)
No change when B is immersed in a solution of B^{n+}(aq) [i.e. $B_{(s)} / B^{n+}(aq)$] (10)
Out of the two electrodes $A_{(s)} / B^{n+}$ (aq) and $B_{(s)} / A^{m+}$ (aq) a change/ dissolution of metal Occurs only in one. (20)
The metal that dissolves is the more reducing metal and the solution contains. (10)
The cation of the other metal (10)

(60 marks)

(b) (i) (I) $A(g) = P(g) + Q(g)$
$0.2 - x \quad x \quad x$
Total no. of moles at equilibrium

$= \dfrac{1.2 \times 10^5 \times 8.314 \times 10^{-3}}{8.314 \times 400\ (4)} = 0.30\ (4)$

$0.2 + x = 0.3$ mol (2)
$\therefore x = 0.1$ mol (2)

$\therefore P_A = P_P = P_Q = \dfrac{0.1}{0.3} \times 1.2 \times 10^5$
(2) (2) (3)
$= 4 \times 10^4$ Pa (4)

$\therefore K_p = \dfrac{4 \times 10^4 \times 4 \times 10^4}{4 \times 10^4}$ (3)

$= 4 \times 10^4$ Pa (4)

(Sub Total 30)

(II) Total no. of moles at equilibrium

$= \dfrac{1.4 \times 10^5 \times 8.314 \times 10^{-3}}{8.314 \times 400\ (2)} = 0.35\ (2)$

$0.4 - x = 0.35$ mol
$x = 0.05$ mol

$P_B = P_D = \dfrac{0.15}{0.35} \times 1.4 \times 10^5$ (2)
(2)
$= 0.6 \times 10^5$
$= 6 \times 10^4$ Pa (4)
$P_R = 2 \times 10^4$ Pa (2)

$\therefore K_p = \dfrac{2 \times 10^4}{6 \times 10^4 \times 6 \times 10^4}$ (3)

$= 0.055 \times 10^{-4}$
$= 5.5 \times 10^{-6}\ Pa^{-1}$ (04)

(Sub Total = 30)

(III) Total pressure inside Z $= (12 + 14) \times 10^4$ (2)
$= 2.6 \times 10^5$ Pa (4)

(IV) $\dfrac{P_B}{P_A} = \dfrac{6 \times 10^4}{4 \times 10^4} = 1.5$
(2) (2)

(ii) For the reaction,
$A(g) = P(g) + Q(g)$
$\Delta_r^0H = 40 + 30 - 50 = 20\ kJ\ mol^{-1}$ (3)
∴ The reaction is endothermic (2)
For the reaction, $B(g) + D(g) = R(g)$
$\Delta_r^0H = 60 - 35 - 45 = -20\ kJmol^{-1}$ (3)
∴ The reaction is exothermic (2)
When the temperature is increased A,P,Q equilibrium shifts to right. (3)
∴ P_A decreases. (3)
When the temperature is increased B,D,R equilibrium shifts to left. (3)
∴ P_B increases. (3)
Therefore, $\dfrac{P_B}{P_A}$ ratio increases. (3)

Sub total= 25 (+ 5Bonus)
Total = 150 marks

PART - C (Essay)

Each question carries a maximum of 150 marks out of 1000

(08) (a) (i) CO/ CObalt (5)
(ii) $1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6 4S^2\ 3d^7$
OR $1S^2\ 2S^2\ 2P^6 3S^2\ 3P^6\ 3d^7\ 4S^2$ (5)
(iii) pink $[CO(H_2O)_6]^{2+}$ (5) Octahedral (2)
blue $[COCl_4]^{2-}$ (5) tetrahedral (2)
(iv) Covalent and Co-ordinate (3)
(v) The concentration of Cl^- ions is not sufficient to form the blue complex. (3)
(vi) It turns pink (5)
(vii) Medical use : ^{60}CO therapy/ γ - radiation (cancer) therapy/vitamin (5)
Industrial use : Alloys/ magnets / humidity indicators Coloured glasses, pigments (5)

(50 marks)

(b) (i) Contact process / production of H_2SO_4
Conversion of SO_2 to SO_3 (4)
Catalyst : V_2O_5 (3)
Ostwald process/production of HNO_3/
Reaction of $NH_3 + O_2$ (air) (4)
Catalyst : pt (3)
Haber process/ production of NH_3/
Reaction of $H_2 + N_2$ (4)
Catalyst : Fe OR iron oxides (3)
Hydrogenation of unsaturated hydrocarbons /
Production of margarine (4)
petroleum refinery / industry (4)
Catalysts pt OR Rh (3)

Any Three of the above

$= 0.6 \times 10^5$

$= 6 \times 10^4$ Pa (4)

$P_B = 2 \times 10^4$ Pa (2)

$\therefore K_p = \dfrac{2 \times 10^4}{6 \times 10^4 \times 6 \times 10^4}$ (3)

$= 0.055 \times 10^{-4}$

$= 5.5 \times 10^{-6}$ Pa^{-1} (04)

(Sub Total = 30)

(III) Total pressure inside Z $= (12 + 14) \times 10^4$ (2)

$= 2.6 \times 10^5$ Pa (4)

(IV) $\dfrac{P_B}{P_A} = \dfrac{6 \times 10^4}{4 \times 10^4} = 1.5$ (2)

(2)

(ii) For the reaction,

$A(g) = P(g) + Q(g)$

$\Delta_r H^\circ = 40 + 30 - 50 = 20$ kJ mol^{-1} (3)

$\therefore$ The reaction is endothermic (2)

For the reaction, $B(g) + D(g) = R(g)$

$\Delta_r H^\circ = 60 - 35 - 45 = -20$ kJmol^{-1} (3)

$\therefore$ The reaction is exothermic (2)

When the temperature is increased A,P,Q equilibrium shifts to right. (3)

$\therefore P_A$ decreases. (3)

When the temperature is increased B,D,R equilibrium shifts to left. (3)

$\therefore P_B$ increases. (3)

Therefore, $\dfrac{P_B}{P_A}$ ratio increases. (3)

Sub total= 25 (+ 5Bonus)

Total = 150 marks

PART - C (Essay)

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(ii) $1S^2\,2S^2\,2P^6\,3S^2\,3P^6 4S^2\,3d^7$

OR $1S^2\,2S^2\,2P^6 3S^2\,3P^6\,3d^7\,4S^2$ (5)

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Catalyst : pt (3)

Haber process/ production of NH_3/

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Catalyst : Fe OR iron oxides (3)

Hydrogenation of unsaturated hydrocarbons /

Production of margarine (4)

petroleum refinery / industry (4)

Catalysts pt OR Rh (3)

Any Three of the above

(ii) $2SO_2 + O_2 \rightarrow 2SO_3$ (5)

$4NH_3 + 5\,O_2 \rightarrow 4\,NO + 6\,H_2O$ (5)

$N_2 + 3H_2 \rightarrow 2NH_3$ (5)

$2H_2 + CO\,(g) \rightarrow CH_3OH(l)$ any three 5 x 3 = ⑮

(iii) By reducing the activation energy of the reaction, heating/ energy costs can be reduced.

By increasing the rate of the reaction the time taken for the process is reduced and thereby the production costs are reduced.

Any TWO of the above (2 x 6)

(iv) Gas molecules are adsorbed on to metal surface where they react. (3)

This provides a new pathway with lower activation energy. (3)

Variable valency of transition metals also helps in electron transfer (oxidation - reduction) reactions. (6)

(60 marks)

(c) (i) $(NH_4)_2CO_3$, $(NH_4)_2SO_4$ & $Ba(OH)_2$ solutions mixed in pairs.

$Ba(OH)_2$

The solutions which do not form a precipitate (OR which do not evolve NH_3) on mixing are $(NH_4)_2CO_3$ and $(NH_4)_2SO_4$ (5)

The other solution is $Ba(OH)_2$ (5)

The solution that gives a precipitate with $Ba(OH)_2$ which is insoluble in dil HNO_3 is $(NH_4)_2SO_4$ (5)

The solution that gives a precipitate with $Ba(OH)_2$ which is soluble in dil HNO_3 is $(NH_4)_2CO_3$. (5)

(ii) $Zn(CH_3COO)_2$, $Ba(OH)_2$ & Na_2CO_3 solutions : adding each solution drop - wise to others.

When adding a solution to the others, if a persistent is formed in one case and a precipitate is formed and then dissolves in excess in the other case, then the added solution is $Ba(OH)_2$. (10)

Then the solution where a persistent precipitate is formed is Na_2CO_3, and the solution where the precipitate dissolves in excess is $Zn(CH_3COO)_2$ (5)

OR

When adding a solution, if a persistent precipitate is formed immediately with the other two solutions, then the added solution is Na_2CO_3 (10)

Of the remaining two, the one that gives a persistent precipitate immediately when added to the other is $Ba(OH)_2$. (5)

The other solution is then identified as $Zn(CH_3COO)_2$ (5)

09) (i) Limestone is heated (5) to give CaO (5)

OR $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$ (10)

If heat not indicated give only 5 marks. CO_2 need not be indicated.

CaO is then reacted with **coke / carbon** (3) in a **graphaite/ electric** arc furnace (5) to give CaC_2 (2)

OR $CaO + 3C \rightarrow CaC_2 + CO$ (5)

CaC_2 is reacted with water to produce acetylene, C_2H_2

OR $CaC_2 + 2\,H_2O \rightarrow C_2H_2 + Ca(OH)_2$ (10)

$Ca(OH)_2$ need not be indicated.

(40 marks)

Total = 150 marks)

(ii) Cheap electricity, water, transport/ roads, storage facilities for C_2H_2, Labour, availability of limestone, availability of coke, effect on the environment.

Any five points 5 x 3 = 15

(iii) Yes, Reasons : Cheap labour, avilability of limestone etc.,

No : Reasons : Expensive electricity, poor road conditions etc., (5)

(iv) Reaction of acetylene with HCl gas to produce vinyl chloride.

$CH \equiv CH + HCl \rightarrow CH_2 - CHCl$ (10)

Polymerisation of vinyl chloride to give PVC.

OR $nCH_2 = CHCl \rightarrow -(CH_2 - CHCl)_n$ (6)

(v) Release of CO_2, Release of CO, Release of HCl, etc., pollution due to dust, pollution due to heat, problems due to mining of limestone etc.,

any three points (3 x 3 = 9)
75 Marks

(b) (i) Phenolphthalein is pink/red in basic medium;
Colourless in acid medium.
Its PH interval is in the basic range (8-10)
MO is orange in basic medium and red in acid medium
Its PH interval is in the acidic range (3-5)
A solution of Na_2CO_3 is (strongly) basic.
Therefore, a mixture of these two indicators will show a reddish - orange colour.
On titration with HCl, Na_2CO_3 will be first converted to $NaHCO_3$.
Phenolphthalein changes colour at this stage (Red to colourless).
Therefore the solution shows the orange colur of MO.
On further titration, $NaHCO_3$ is converted to CO_2 and H_2O.
At this stage MO changes colour from orange to red.

(2 x 12 + 1 for ≤ 14)
(9) b (i) = 25 Marks

(ii) $2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O \xrightarrow{CO_2} 2NaHCO_3$

$Na_2CO_3 + H_2O + CO_2 \rightarrow 2NaHCO_3$

$NaHCO_3 + HCl \rightarrow NaCl + CO_2 + H_2O$ (3 x 5)

The conc. of Na_2CO_3 solution = 0.08 mol dm^{-3}

The amount of $NaHCO_3$ formed in 25.0 cm^3 of solution when CO_2 was passed = $\frac{0.08 \times 25 \times 2 \text{ mol}}{1000}$ (3)

= 0.004 mol (5)

Total amount of $NaHCO_3$ reacted with HCl = $\frac{0.5 \times 28.0 \text{ mol}}{1000}$ (2)

= 0.014 mol (5)

The amount of $NaHCO_3$ formed from NaOH = 0.014 - 0.004 mol

= 0.01 mol (5)

Therefore the amount of NaOH in 25 cm^3 of the original solution = 0.01 mol (5)

The concentration of NaOH in solution = $\frac{0.01 \times 1000}{25}$ mol.dm^{-3} (5)

= 0.40 mol.dm^{-3} (5)

(9) b (ii) = 50 Marks

(10) (a) (i) Iron pyrites/FeS_2, S deposits, petrolium, ZnS, CuS, $CuFeS_2$, PbS

(any 2 x 05 = 1

(ii) Forward reaction is favoured by low temperature (1
Reaction occurs with reduction in the number of mole
(5). Therefore it is favoured by high pressure (5).

(iii) The temperature used is about 450°C. (5)
Although, according to the Le Chatelier's principle, a low temperature is suitable, the rate of the reaction is too low to be economical (10)
High pressure will require more expensive equipment (10) and also will corrode the equipment by reacting with SO_2 and SO_3. (10)
Therefore, a pressure of 1-3 atm is used. (5)

(iv)

	Combustion engine	Environment
S	Corrosion (5)	emission of SO_2/SO_3 (5)
Lead	pb deposit on engine parts (5)	Emission of pb to the environment (5)

(90 marks

(b)

$SO_3^{2-} + H_2O \rightarrow SO_4^{2-} + 2H^+ + 2e$ (4

$I_2 + 2e \rightarrow 2I^-$ (4

$2S_2O_3^{2-} \rightarrow S_4O_6^{2-} + 2e$ (4

The total amount of I_2 in 25 cm^3 of 0.1 M I_2 solution = $\frac{25 \times 0.1}{1000}$ = 0.0025 mol (4

The amount of $Na_2S_2O_3$ reacted with I_2 remaining after reaction with SO_3^{2-} = $\frac{0.1 \times 30 \text{ mol}}{1000}$ (4

∴ Amount of I_2 reacted with $Na_2S_2O_3$ = $\frac{0.1 \times 30 \text{ mol}}{1000 \times 2}$ = 0.0015 (4
(4)

∴ Amount of I_2 reacted with SO_3^{2-} = (0.0025 - 0.0015) mol
0.001 mol

∴ The concentration of SO_3^{2-} in the solution = $\frac{0.001 \times 1000}{10}$
= 0.1 $moldm^{-3}$

$SO_4^{2-} + Ba^{2+} \rightarrow BaSO_4$.

Relative formula mass of SO_4^{2-} = 96

Relative formula mass of $BaSO_4$ = 233

The mass of $BaSO_4$ obtained = 0.932 g

∴ The mass of SO_4^{2-} = $\frac{96 \times 0.932}{233}$
= 0.384 g

∴ The amount of SO_4^{2-} in 10 cm^3 of solution = $\frac{0.384}{96}$
= 0.004 mol

∴ The original amount of SO_4^{2-} = 0.004 - 0.001 mol
= 0.003 mol

∴ The concentration of SO_4^{2-} = $\frac{0.003 \times 1000}{}$

Reaction of acetylene with HCl gas to produce vinyl chloride (10)

$CH \equiv CH + HCl \rightarrow CH_2 - CHCl$

Polymerisation of vinyl chloride to give PVC. (6)

OR $nCH_2 = CHCl \rightarrow -(CH_2 - CHCl)_n$

Release of CO_2, Release of CO, Release of HCl, etc., pollution due to dust, pollution due to heat, problems due to mining of limestone etc.,

any three points (3 x 3 = 9)
75 Marks

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$a_2CO_3 + H_2O + CO_2 \rightarrow 2NaHCO_3$

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= 0.014 mol (5)

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= 0.40 mol.dm^{-3} (5)

(9) b (ii) = 50 Marks

(10) (a) (i) Iron pyrites/FeS_2, S deposits, petroleum, ZnS, CuS, $CuFeS_2$, PbS
(any 2 x 05 = 10)

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(iv)

	Combustion engine	Environment
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Lead	pb deposit on engine parts (5)	Emission of pb to the environment (5)

(90 marks)

(b)

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The amount of $Na_2S_2O_3$ reacted with I_2 remaining after reaction with SO_3^{2-} $= \frac{0.1 \times 30 \text{ mol}}{1000}$ (4)

∴ Amount of I_2 reacted with $Na_2S_2O_3$ $= \frac{0.1 \times 30 \text{ mol}}{1000 \times 2}$ (4) = 0.0015 mol (4)

∴ Amount of I_2 reacted with SO_3^{2-} = (0.0025 - 0.0015) mol
0.001 mol (4)

∴ The concentration of SO_3^{2-} in the solution $= \frac{0.001 \times 1000}{10}$

= 0.1 moldm^{-3} (2)

$SO_4^{2-} + Ba^{2+} \rightarrow BaSO_4$ (2)

Relative formula mass of SO_4^{2-} = 96 (1)

Relative formula mass of $BaSO_4$ = 233 (1)

The mass of $BaSO_4$ obtained = 0.932 g

∴ The mass of SO_4^{2-} $= \frac{96 \times 0.932}{233}$ (2)

= 0.384 g

∴ The amount of SO_4^{2-} in 10 cm^3 of solution $= \frac{0.384}{96}$ (2)

= 0.004 mol

∴ The original amount of SO_4^{2-} = 0.004 - 0.001 mol (4)

= 0.003 mol

∴ The concentration of SO_4^{2-} $= \frac{0.003 \times 1000}{10}$ (4)

= 0.3 mol dm^{-3} (4)

(60) Marks