FWC

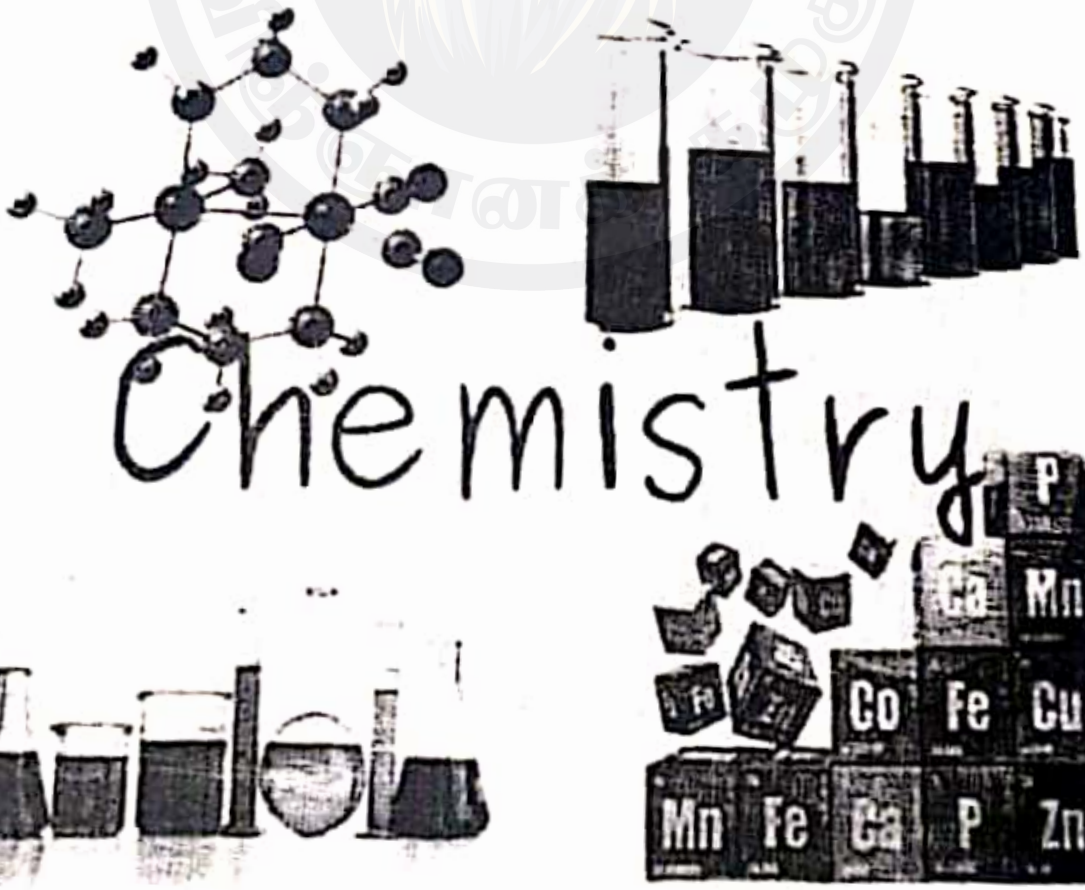
வடமாகாணக் கல்வித் திணைக்களத்துடன் இணைந்து
தொண்டைமானாறு வளவாளர் நிலையம் நடாத்தும்
தவணைப் பரீட்சை, நவம்பர் - 2019

In Collaboration with Provincial Department of Education Northern Province
Conducted by Field Work Centre, Thondaimanaru
Term Examination, November - 2019

Grade - 13 (2020) **Chemistry** **Marking Scheme**

Part - I MCQ

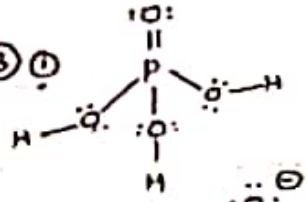
01) 3	11) 5	21) 3	31) 1	41) 1
02) 1	12) 3	22) 1	32) 5	42) 2
03) 2	13) 5	23) 1	33) 4	43) 2
04) 4	14) 4	24) 5	34) 3	44) 1
05) 5	15) 1	25) 4	35) 2	45) 5
06) 1	16) 2	26) 5	36) 1	46) 5
07) 3	17) 3	27) 2	37) 4	47) 3
08) 3	18) 5	28) 5	38) 4	48) 4
09) 2	19) 1	29) 5	39) 3	49) 3
10) 4	20) 2	30) 3	40) 2	50) 1



Part - II

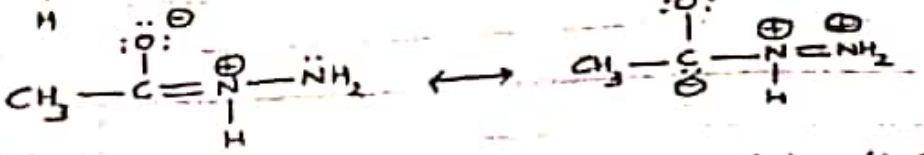
① (A) (i) Cl (ii) S (iii) Al (iv) Na (v) Ar (vi) Al (04×6 = 24)

(B) (i)



(07)

(ii)



(04) (04) Unstable (02)

(iii)

	O	C	N	N
	1	3	4	5
	4	2	3	3
	Tetrahedral	linear	Trigonal planar	Trigonal planar
	sp^3	sp	sp^2	sp^2
	Angular	Linear	Angular	Trigonal planar

(01×16 = 16)

(iv)

H	1S	O	sp^3
O^1	sp^3	C^2	sp
C^3	sp	N^4	sp^2
N^4	sp^2	N^5	sp^2
N^5	sp^2	F	2p

(01×10 = 10)

(v)

C^2	2p	C^3	2p
N^4	2p	N^5	2p

(01×4 = 04)

(I)(B) 47 marks

(C)

(i)	3	2	✓	✓	
(ii)	✓	1	✓	3p	
	✓	1	✓	3p	
	✓	1	✓	3p	
(iii)	✓	0	0	✓	
(iv)	✓	1	✓	2p	
(v)	✓	0	0	✓	

(01×14 = 14)

(1) (i) $BaSO_4 < MgSO_4 < CaSO_4$

(ii) $NO_3^{3-} < N_3^- < NO_2^- < NO_2^+$

(iii) $LiF < NaF < KF$

(05×3) = 15

(2) (A) (i) K (07) (ii) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$ (06) (iii) K_2O, K_2O_2, KO_2 (03×3) = 09

(iv) I KO_2 (03)

II $2KO_2 + 2H_2O \rightarrow 2KOH + H_2O_2 + O_2$ (05)

III $4KO_2 + 2H_2O \rightarrow 4KOH + 3O_2$ (05)

(v) Double Cobalt glass (03)

(vi) Y - Li (03)

(vii) Diagonal Relationship (03)

(viii) • decomposition of Li_2CO_3 is same as $MgCO_3$ (03)

• decomposition of $LiNO_3$, LiOH are similar to compounds of Mg (03)

• Li can form N^{3-} like Mg (03)

(2)(A) 50 marks

(B) I

(i) NaOH (ii) HCl (iii) NaBr (iv) HNO_3 (v) $Na_2S_2O_3$ (03×5=15)

II

A - NH_3 B - $PbCl_2$ C - AgBr D - CO_2 E - PbS_2O_3

(04×5 = 20)

III

$PbCl_{2(s)} \rightleftharpoons Pb^{2+}_{(aq)} + 2Cl^-_{(aq)}$

$AgBr_{(s)} + NH_{3\,(aq)} \rightleftharpoons [Ag(NH_3)_2]Br_{(aq)}$

IV

$PbS_2O_3 \rightarrow PbS\downarrow + SO_3$

(05×3 = 15)

(2)(B) 50 marks

(3) (i) I - To reduce the reaction between Mg tape and HCl (05)

II It is difficult to get initial reading due to the fast reaction (05)

(ii) I - NO, (05)

II Because, Rapid reaction takes place, difficult to get initial reading (05)

(iii) $Mg + 2HCl \rightarrow MgCl_2 + H_2$ (07)

(iv) $V_{H_2} = (44.00 - 3.10) = 43.90\ cm^3$ (04+01)

(v) $\frac{760 - 31.8}{760} \times 10^5\ Nm^{-2}$ (04+01)

(05)

(vi) $pV = nRT$ (05)

P – Pressure exerted by gas n – Amount of substance T – Absolute temperature

V – Volume occupied by gas R – universal gas constant (01×5 = 05)

(vii) $\frac{788.2}{760} \times 10^5\ Pa \times \frac{43.8 \times 10^{-6}\ m^3}{8.314\ J\,mol^{-1}K^{-1} \times 303\ K}$

$= 1.665 \times 10^{-3}\ mol$ {(03+01) × 5 = 20}

(05)

(viii) H_2 acts as ideal gas

(ix) $n = \frac{w}{M}$ (05) $M = \frac{0.04\,g}{1.665 \times 10^{-3}\ mol}$ (04+01)

$= 24.02\ g\,mol^{-1}$ (04+01)

Relative molecular mass Mg ≅ 24 (04+01)

(A) (i)

A – $CH_3-C(OH)(C_2H_5)-CH_2-CH_2-CH_3$

B – $CH_3-C(OH)(C_2H_5)-C(CH_3)-H$

C – $C_2H_5-C(OH)(C_2H_5)-C_2H_5$

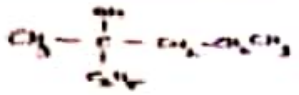
• Structures A, B and C are interchangeable.

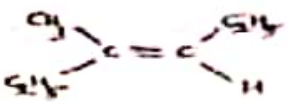
(06 × 3 = 18)

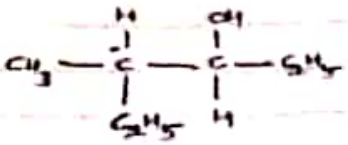
(ii)

$C_2H_5-C(OH)(C_2H_5)-C_2H_5$ (06)

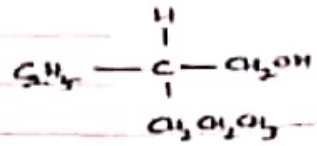
(iii)

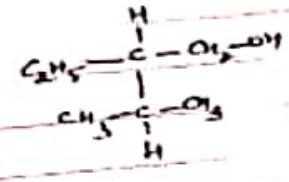
A – 

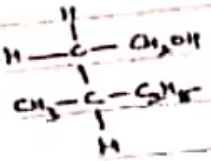
B – 

H 

(06 × 3 = 18)

(iv) 





(06 × 3 = 18)

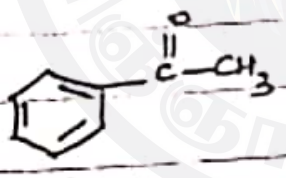
(v) When $H^+/KMnO_4$ or $H^+/K_2Cr_2O_7$ is added to the A, B, C and D by heating; (03)

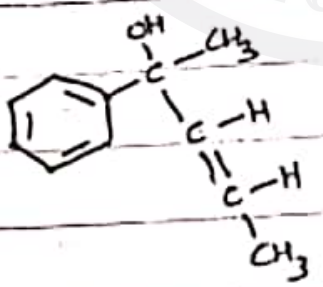
* D shows colour change → $H^+/KMnO_4$ – Violet to colourless, $H^+/K_2Cr_2O_7$ orange-green (03)
* A, B, C do not show any colour change

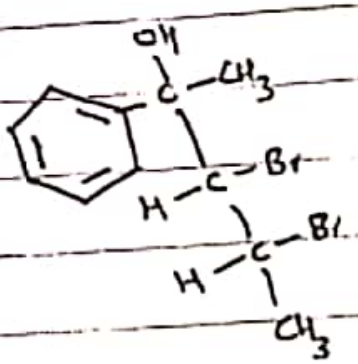
④Ⓐ 66 marks (05 × 2½ = 10)

(B) I P – CaC_2 Q – Na/C_2H_5Cl

II R – $C_2H_5-C\equiv C^-Na^+$

S – 

T – 

U – 

(06 × 4 = 24)

④Ⓑ 34 marks

Part II B

(5) (A) (b) $CH_3COOH_{(aq)} + H_2O_{(l)} \rightleftharpoons CH_3COO^-_{(aq)} + H_3O^+_{(aq)}$

Initial:	0.02	–	–	mol dm^{-3}
At equilibri(0.02−x)			x	mol dm^{-3}

$$K_a = \frac{[CH_3COO^-_{(aq)}][H_3O^+_{aq}]}{[CH_3COOH_{aq}]} \quad \text{---} \quad (05)$$

$$1.8 \times 10^{-5} \text{ mol dm}^{-3} = \frac{x^2}{(0.02-x)\text{ mol dm}^{-3}} \quad \text{---} \quad (05)$$

Since $x << 0.02$, $0.02 - x \approx 0.02$

$\therefore x^2 = 36 \times 10^{-8} \text{ mol}^2\text{dm}^{-6}$

$\Rightarrow x = 6 \times 10^{-4} \text{ mol dm}^{-3}$

$[H_3O^+_{aq}] = 6 \times 10^{-4} \text{ mol dm}^{-3}$ --- (05)

$pH = -\log_{10}[H_3O^+_{aq}]$

$= -\log_{10}(6 \times 10^{-4}) = 4 - \log_{10}6$

$= 4 - 0.7782 = 3.2218$ -- (05)

(B) (a) Amt. of moles of CH_3COOH in 25 cm^3 sol^n

$= 0.02 \text{ mol dm}^{-3} \times 25 \times 10^{-3} \text{ dm}^3$

$= 0.5 \times 10^{-3} \text{ mol}$ -- (03)

Amt. in moles of NaOH added

$= 0.03 \text{ mol dm}^{-3} \times 12.5 \times 10^{-3} \text{ dm}^3$

$= 3.75 \times 10^{-4} \text{ mol}$ -- (03)

$CH_3COOH_{aq} + NaOH_{aq} \longrightarrow CH_3COONa_{aq} + H_2O_{(l)}$

Remainining amt. of $CH_3COOH = (5 \times 10^{-4} - 3.75 \times 10^{-4})$ mol

$= 1.25 \times 10^{-4} \text{ mol}$ -- (03)

Concentration of remaining CH_3COOH

$= \frac{1.25 \times 10^{-4} \text{ mol}}{37.5 \times 10^{-3} \text{ dm}^3}$ -- (03)

Concentration of $CH_3COO^-Na^+$ formed

$= \frac{3.75 \times 10^{-4} \text{ mol}}{37.5 \times 10^{-3} \text{ dm}^3}$

$\therefore$ — (02)

$K_a = \frac{[CH_3COO^-_{(aq)}][H_3O^+_{(aq)}]}{[CH_3COOH_{(aq)}]}$ ---

$[H_3O^+_{(aq)}] = \frac{K_a \times [CH_3COOH]}{[CH_3COO^-]}$

$= 1.8 \times 10^{-5} \text{ mol dm}^{-3} \times \frac{1.25 \times 10^{-4}}{37.5 \times 10^{-5}}$ mol dm^{-3} --- (03)

$\frac{3.75 \times 10^{-4}}{37.5 \times 10^{-5}}$ mol dm^{-3}

$= \frac{1.8 \times 10^{-5} \times 1.25 \times 10^{-4}}{3.75 \times 10^{-4}} = 6 \times 10^{-6}$ mol dm^{-3} --- (01)

$pH = -\log[H_3O^+]$

$= -\log(6 \times 10^{-6}) = 6 - \log 6.$

$= 5.2218$ --- (03)

(ii) $HCl_{(aq)} \xrightarrow{H_2O_{(l)}} H_3O^+_{(aq)} + Cl^-_{(aq)}$ (04)

$[H_3O^+_{(aq)}] = 0.02$ mol dm^{-3} ---

$pH = -\log(0.02 \text{ mol dm}^{-3}) = 2 - \log_{10} 2$ (05)

$= 1.6990$ ---

(iii) Contribution of H^+ ions from CH_3COOH can be neglected in comparison to that of HCl --- (05)

After mixing, $[HCl] = 0.01$ mol dm^{-3} --- (05)

$\therefore pH = -\log(0.01)$

$= 2$ --- (05)

Q5 (A) 70

B (I) 45

(II) Definitions of std. enthalpy of formation and enthalpy of combustion. --- 2 × 05 = 10

$H-\underset{H}{\overset{H}{C}}-\overset{O}{\underset{H}{\overset{\|}{C}}}_{(g)} + \frac{5}{2}(O=O)_{(g)} \xrightarrow{\Delta H} 2(O=C=O)_{(g)} + 2H-O-H_{(g)}$

$\Delta H_1 \downarrow$ $\qquad \Delta H_2 \downarrow$ cycle (10)

$2C_{(g)} + 4H_{(g)} + 6O_{(g)}$

$\Delta H_1 = 4 \times \Delta H_D(C-H) + \Delta H_D(C=O) + \frac{5}{2} \times \Delta H_D(O=O) + \Delta H_D(C-C)$ --- (05)

$= [(4 \times 412) + (743) + (\frac{5}{2} \times 496) + 348]$ kJ mol^{-1} --- (05)

$= 3979$ kJ mol^{-1} --- (05)

$\Delta H_2 = 4 \times \Delta H_D(C=O) + 4 \times \Delta H_D(O-H)$

$= [(4 \times 743) + (4 \times 463)]$ kJ mol^{-1} $= 4824$ kJ mol^{-1}

chemist

By Hess's law, $\Delta H = \Delta H_1 - \Delta H_2$

$= (-3979 - 4 \times 234)\ kJ\,mol^{-1}$

$= -1913\ kJ\,mol^{-1}$ ---(05)

(II) $CO_{(g)} + \frac{1}{2}O_{2(g)} \longrightarrow CO_{2(g)}$, $\Delta H^\circ = -284\ kJ\,mol^{-1}$ ---①

$2NO_{(g)} + 2CO_{(g)} \longrightarrow N_{2(g)} + 2CO_{2(g)}$, $\Delta H^\circ = -744\ kJ\,mol^{-1}$ ---②

② × 2 − ① ⇒ $N_{2(g)} + O_{2(g)} \longrightarrow 2NO_{(g)}$

$\therefore 2 \times \Delta H_{f(NO)}^\circ = 2 \times -284\ kJ\,mol^{-1} + 744\ kJ\,mol^{-1}$

$= 180\ kJ\,mol^{-1}$ ---(05)

$\Delta H_{f(NO)}^\circ = 90\ kJ\,mol^{-1}$ ---(05)

(I) For the given reaction

$\Delta H_R^\circ = \sum \Delta H_{Products}^\circ - \sum \Delta H_{Reactants}^\circ$

$= [(4 \times 90\ kJ\,mol) + (6 \times -242\ kJ\,mol)] - [(-46\ kJ\,mol^{-1} \times 4) + 0\ kJ\,mol]$

$= -908\ kJ\,mol^{-1}$ ---(05)

(II) $\Delta S_R^\circ = \sum S_{Products}^\circ - \sum S_{Reactants}^\circ$

$= [(211\ J\,mol^{-1}K^{-1} \times 4) + (189\ J\,mol^{-1}K^{-1} \times 6)] - [192\ J\,mol^{-1}K^{-1} + 205\ J\,mol^{-1}K^{-1}]$

$= 181\ J\,mol^{-1}K^{-1}$ ---(05)

III) $\Delta G^\circ = \Delta H_R^\circ - T\Delta S_R^\circ$ ---(05)

$= -908\ kJ\,mol^{-1} - [298K \times 181 \times 10^{-3}\ kJ\,mol^{-1}K^{-1}]$

$= -961.9\ kJ\,mol^{-1}$ ---(05)

Since $\Delta G^\circ < 0$, the reaction is ~~non~~ spontaneous ---(05)

Q5 (B) ⇒ (10)

d) Initial rates ⇒ 16×10^{-4}, 32×10^{-4}, 4×10^{-4}, 4×10^{-4} } $4 \times 04 = 16$

(units not necessary).

d) $R = k[X]^a[Y]^b[Z]^c$ ---(04)

16×10^{-4} mol dm^{-3} s^{-1} = k(0.2 mol dm^{-3})^a(0.1 mol dm^{-3})^b(0.1 mol dm^{-3})^c ---(i)

32×10^{-4} mol dm^{-3} s^{-1} = k(0.2 × 2)^a(0.2 × 1)^b(0.1 × 1)^c ---(ii)

4×10^{-4} mol dm^{-3} s^{-1} = k(0.1 × 1)^a(0.1 × 1)^b(0.2 × 1)^c ---(iii)

4×10^{-4} mol dm^{-3} s^{-1} = k(0.1 × 1)^a(0.1 × 1)^b(0.1 × 1)^c ---(iv)

Four eqns $4 \times 05 = (20)$

(i) ÷ (iii) $\Rightarrow \frac{1}{1} = \left(\frac{1}{2}\right)^b \Rightarrow b = 1$

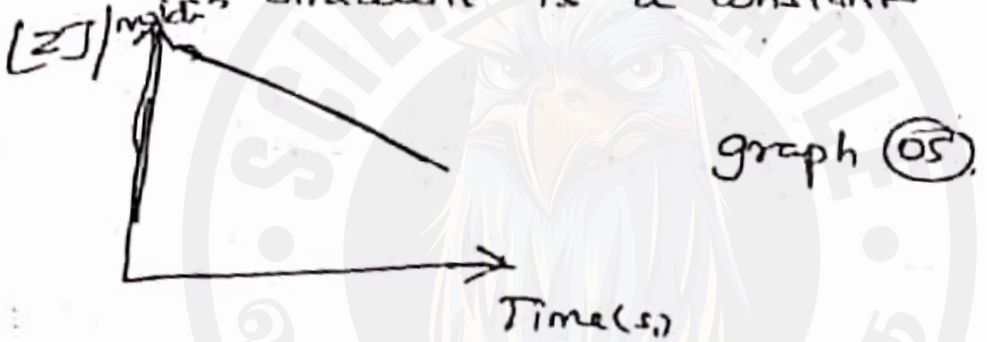
(ii) ÷ (iv) $\Rightarrow 4 = 2^a \Rightarrow a = 2$

(iii) ÷ (iv) $\Rightarrow 1 = 2^c \Rightarrow c = 0$

$3 \times 05 = (15)$

$\therefore R = k[X]^2[Y][Z]^0 = k[X]^2[Y]$

(m) Since order w.r.t Z is 0, rate is independent of the concentration of Z. --- (05)



graph (05)

(n) The rate will increase by a factor 8 --- (05)

(iii) (contd) $k = \frac{R}{[X]^2[Y]}$

$= \frac{16 \times 10^{-4} \text{ mol dm}^{-3} \text{s}^{-1}}{(0.2 \text{ mol dm}^{-3})^2 (0.1 \text{ mol dm}^{-3})}$

$= 0.4 \text{ mol}^{-2} \text{dm}^6 \text{s}^{-1}$ --- (05)

(iii)

(a) (i) M = Co , Oxidation state : +2 / +3 (05)

(ii) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^7$ --- (10)

(iii) $n = 2$, $n = 6$ --- 2e or = (10)

(iv) Q : $Co(OH)_2$ --- (05) , R : $[Co(NH_3)_6]^{2+}$ --- (05) , S : $[CoCl_4]^{2-}$ --- (05)

(v) P ⇒ hexaaquacobalt(II) ion
R ⇒ hexaammine cobalt(II) ion
S ⇒ tetrachloridocobaltate(II) ion
} 3 × 10 = (30)

(vi) Yellow colour is due to the formation of $[Co(NH_3)_6]^{2+}$. Further addition of concentrated NH_3 leads to the formation of this.

However, due to auto-oxidation $[Co(NH_3)_6]^{2+}$ is converted to $[Co(NH_3)_6]^{3+}$ which is yellow brown. (15)

(i) +3 ---- (10)

(ii) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^7$ ---- (10)

(iii) NH_3 ---- (05)

(iv) A ⇒ $[Co(NH_3)_4 I_2]NO_2$, B ⇒ $[Co(NH_3)_4(NO_2)I]I$
2 × 05 = 10

(v) NO_2^- any test : eg : Evolution of brown coloured gas on addition of dil HCl

--- (15)

(b) (i) $K_c = \dfrac{[C]^3}{[A][B]^2}$ ---- (05)

75

$= \dfrac{(0.3\ mol\ dm^{-3})^3}{(0.4\ mol\ dm^{-3})(0.1\ mol\ dm^{-3})^2}$ ---- (05)

$= \dfrac{27}{4} = 6.75$ ---- (05)

(ii) $A_{(g)} + 2B_{(g)} \rightleftharpoons 3C_{(g)}$

Initially: a b —

At eq^m: $(a-x)$ $(b-2x)$ $3x$

$3x = 0.3$
$x = 0.1$ ---- (05)

$a - x = 0.4$
$a = 0.5\ mol$

$b - 2x = 0.1$
$b = 0.3\ mol$

Initial amounts of $A = 0.5\ mol$, $B = 0.3\ mol$ } 2×05 (10)

(iii) ~~After 10 s~~, At time $t = t$,

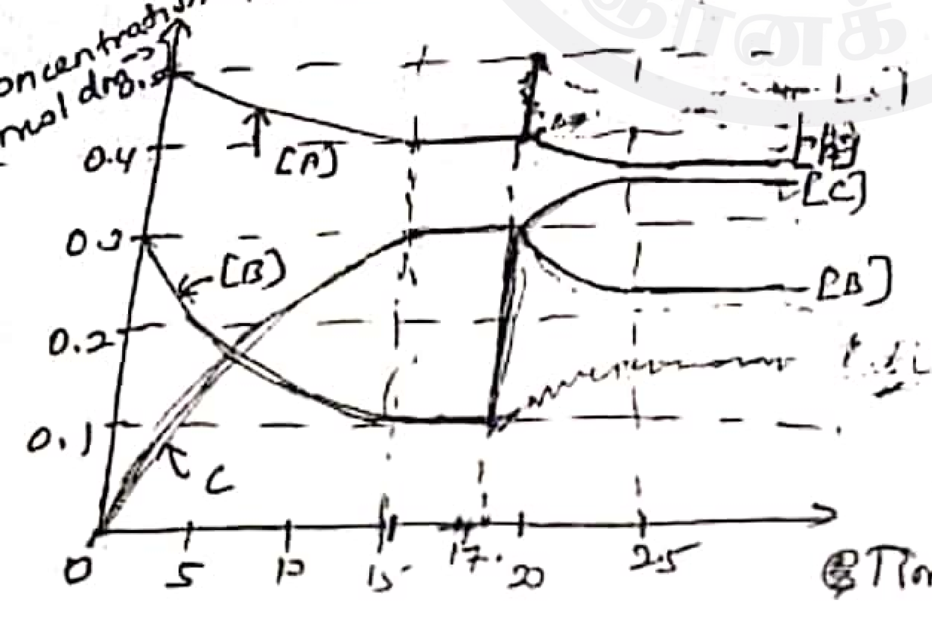
$Q_c = \dfrac{[C]^3_{t=0}}{[A]_{t=0}[B]^2_{t=0}}$

$= \dfrac{(0.3\ mol\ dm^{-3})^3}{(0.6\ mol\ dm^{-3})(0.3\ mol\ dm^{-3})^2}$ ---- (10)

$= 0.5$ ---- (05)

$Q_c < K_c$

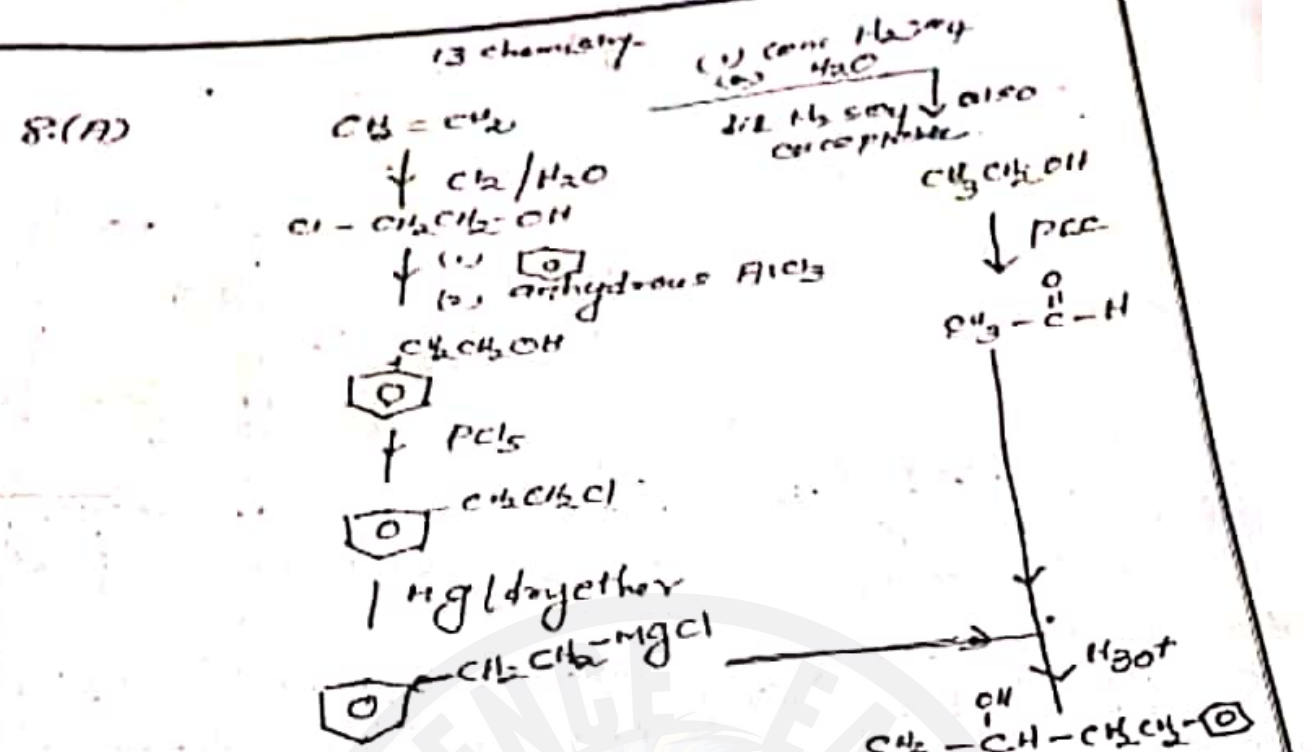
∴ The reaction proceeds in the forward direction. ---- (05)



graph (25)

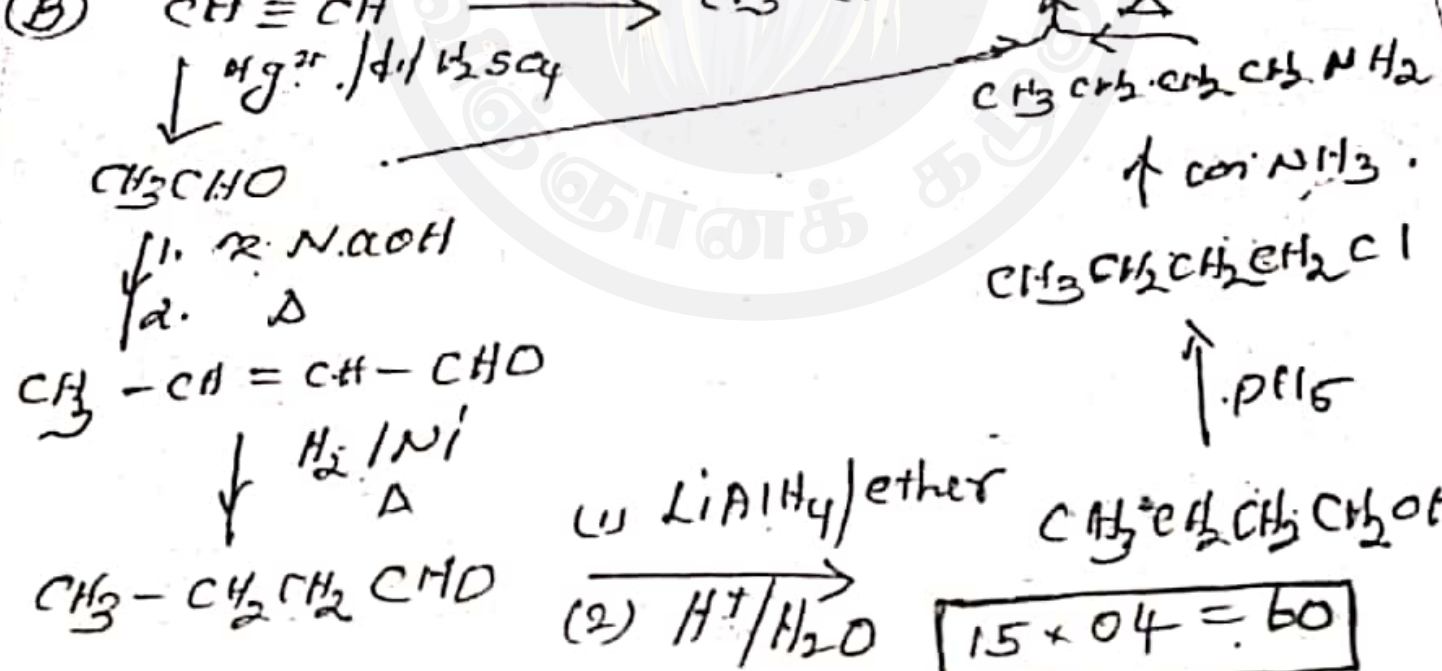
- Plots of A, B and C before equilibrium → 3×05
- for graphs indicating new equilibrium (10)

8:(A)



$15 \times 04 = 60$

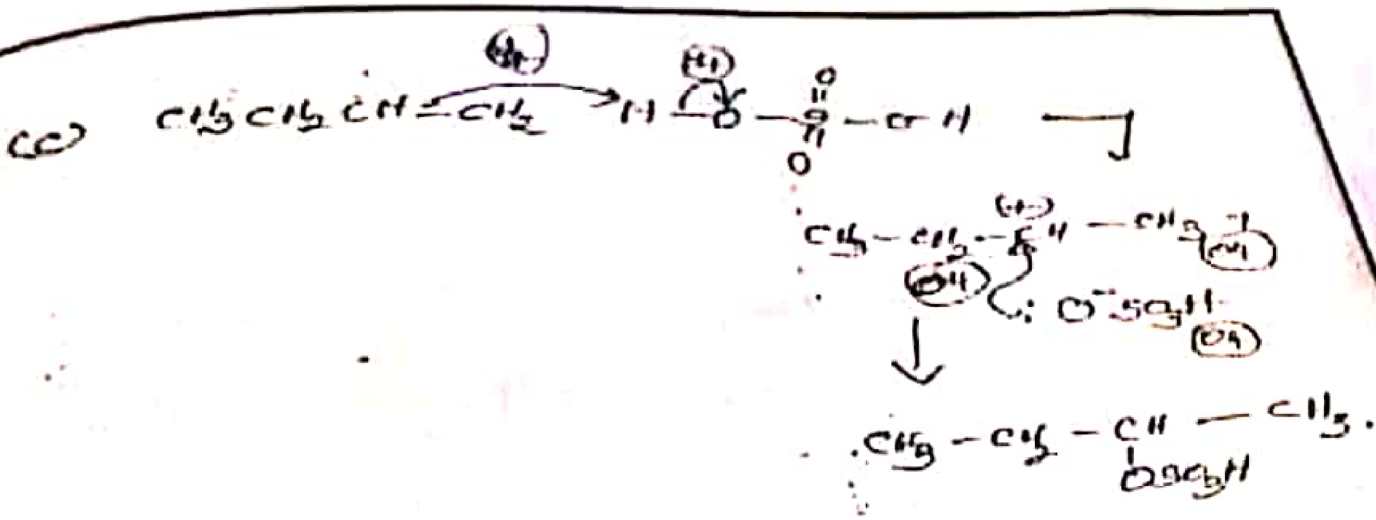
(B)



$15 \times 04 = 60$

13

(c)



[illegible] $CH_3-CH_2-CH(OSO_3H)-CH_3$.

(10)

30

150

Q4.

a) I. Ag^+, Fe^{3+}, CrO_4^{2-}, NO_3^-

II. x_1 – Ag_2O
x_2 – $Fe(OH)_3$
x_3 – $Ag_2S_2O_3$
x_4 – Ag_2S
x_5 – $[Fe(SCN)(H_2O)_5]^{2+}$
x_6 – AgCl
x_7 – $CaCO_3$
x_8 – $Ca(HCO_3)_2$
x_9 – CaC_2O_4
x_{10} – HNO_2

[14 × 0.5 = 7 marks]

b) molar mass of AgBr = 188 g mol^{-1} ✓

mole of AgBr = $\frac{3.7619}{188 g mol^{-1}}$ ✓

= 2×10^{-3} mol ✓

So, mole of Br^- = 2×10^{-3} mol ✓

C_{Br^-} = $\frac{2 \times 10^{-3} mol}{25 \times 10^{-3} dm^3}$ ✓

= 0.08 mol dm^{-3} ✓

$S^{2-} + 6MnO_4^- + 28H^+ \longrightarrow 6Mn^{2+} + 5SO_2 + 14H_2O$

$MnO_4^- + 8H^+ + C_2O_4^{2-} \longrightarrow 2Mn^{2+} + 2CO_2 + 4H_2O$

(10 mar

Mole Of $C_2O_4^{2-}$ = 0.3 mol dm^{-3} × 20 × 10^{-3} dm

= 6×10^{-3} mol ✓

Excess MnO_4^- mole

$$\frac{n_{MnO_4^-}}{n_{C_2O_4^{2-}}} = \frac{2}{5} \checkmark$$

$$n_{MnO_4^-} = \frac{2}{5} \times 6\times10^{-3} \text{ mol} \checkmark$$

$$= 2.4\times10^{-3} \text{ mol} \checkmark$$

Initial mole of MnO_4^- $= 0.2 \text{ mol dm}^{-3} \times 30\times10^{-3} \text{ dm}^3$

$= 6\times10^{-3}$ mol ✓

mole of MnO_4^- react with Hg_2S

$= 6\times10^{-3} \text{ mol} - 2.4\times10^{-3} \text{ mol}$

$= 3.6\times10^{-3}$ mol ✓

So, mole of Hg_2S

$$\frac{n_{Hg_2S}}{n_{MnO_4^-}} = \frac{5}{6} \times 3.6\times10^{-3} \text{ mol} \checkmark$$

$$= 3\times10^{-3} \text{ mol} \checkmark$$

∴ no. of mole of Hg^{2+} in $25 cm^3$

$= 3\times10^{-3}$ mol ✓

$$C_{Hg^{2+}} = \frac{3\times10^{-3} \text{ mol}}{25\times10^{-3} \text{ dm}^3} \checkmark$$

$$= 0.12 \text{ mol dm}^{-3} \checkmark$$

No. of mole of $Ba(OH)_2$ = 0.4 mol dm^{-3} × 25×10^{-3} dm^3 ✓
= 10×10^{-3} mol. ✓

So, OH^- mole = 20×10^{-3} mol. ✓

$H^+_{(aq)} + OH^-_{(aq)} \longrightarrow H_2O_{(l)}$ (03 marks)

So, No. of mole of H^+ = 20×10^{-3} mol ✓

$C_{H^+} = \frac{20\times10^{-3}\ mol}{25\times10^{-3}\ dm^3}$ ✓

= 0.8 mol dm^{-3} ✓

✓26 × 2.5 = 65 marks

3 equation = 15 marks

80 marks

70	+	80	= 150

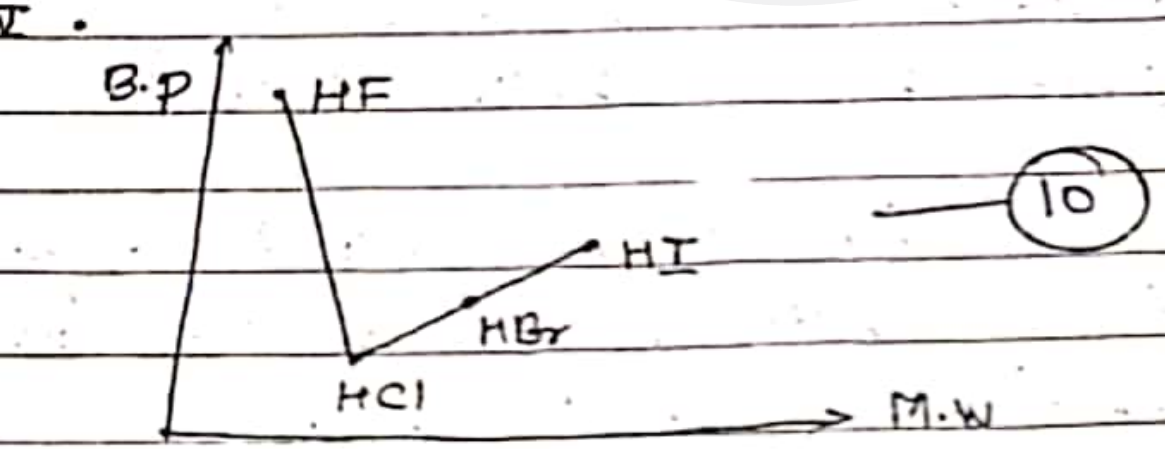
I. Cl, Cl_2 — (10)

II. $1s^2 2s^2 2p^6 3s^2 3p^5$ — (5)

III. -1, +1, +3, +5, +6, +7, 0 — (4)

IV. HOCl, $HClO_2$, $HClO_3$, $HClO_4$ — (4)

V.



10

(∴)

As molecular mass/size increases, boiling point increases. But with HF boiling point is higher than expected because of H-bonding between HF molecules. —(1m)

VI. $8\,NH_3$ (excess) $+ 3Cl_2 \longrightarrow N_2 + 6NH_4Cl$ —(1)

$3Cl_2 + 6NaOH \longrightarrow 5NaCl + NaClO_3 + 3H_2O$ —(1)

VII.
- to make drinking water safe
- paper products
- plastics
- dyes
- textiles
- medicines —(2)

(b)

	Na_2O	MgO	Al_2O_3	SiO_2	P_4O_{10}	SO_3	Cl_2O_7
Oxidation No:	+1	+2	+3	+4	+5	+6	+7
Bonding type	I	I	I	Nc	c	c	c
Nature	Strong B	B	Am	Very weak A	weakly A	A	Strong A

$28 \times 1 = (28)$

I - Ionic Nc - Network covalent c - Covalent

B - Basic Am - Amphoteric A - Acidic