வடமாகாணக் கல்வித் திணைக்களத்துடன் இணைந்து
தொண்டைமானாறு வெளிக்கள நிலையம் நடாத்தும்
தவணைப் பரீட்சை, மார்ச் - 2020

Conducted by Field Work Centre, Thondaimanaru
In Collaboration with Provincial Department of Education
Northern Province Term Examination, March - 2020

FWC

தரம் :- 13 (2020)	இரசாயனவியல்	புள்ளித்திட்டம்

பகுதி I

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

[1] (A) i) $CO_2 > HCN > HCHO > CH_3Br$

ii) $RbNO_3 > KNO_3 > NaNO_3 > LiNO_3$

iii) $F > P > S > Be$

iv) $(3, 1, 0, +\frac{1}{2}) > (3, 0, 0, +\frac{1}{2}) > (2, 1, 0, +\frac{1}{2}) > (2, 0, 0, +\frac{1}{2})$

v) $SO_3 > SO_2 > SO_4^{2-} > SO_3^{2-}$

vi) $Cl > P > Na > Al$ $\boxed{6 \times 05 = 30}$

(B) i)

N^1	C^3	C^4	O^8
2	4	3	4
Linear	Tetrahedral	Trigonal Planar	Tetrahedral
Linear or —	Tetrahedral	Trigonal Planar	angular

$\boxed{16 \times 01 = 16}$

ii) N^1 SP(h.o) C^2 SP(h.o)
C^3 SP^2(h.o) O^7 SP^2(h.o)
C^4 SP^2(h.o) O^8 SP^3(h.o)
C^5 SP^3(h.o) C^6 SP^3(h.o)

$\boxed{8 \times 01 = 8}$

iii) N^1 2P(a.o) C^2 2P(a.o)
C^4 2P(a.o) O^7 2P(a.o) $\boxed{4 \times 01 = 4}$

(iv)

$$\begin{array}{c} :\ddot{O}: \\ \| \\ \ddot{O}=S=\ddot{O} \end{array} \qquad \qquad \begin{array}{c} :\ddot{Cl}: \\ | \\ H - C - H \\ | \\ :\ddot{Cl}: \end{array}$$

$\boxed{7 \times 02 = 14}$

VSEPR Pair	3	VSEPR Pair	4
σ Pair	3	σ Pair	4
Lone Pair	0	Lone Pair	0
shape	Trigonal Planar	Shape:	Tetrahedral

(C) (i) ~~Basic~~ Linear overlaping (ii) σ bond.
(iii) Latteral overlaping (iv) π bond.

$\boxed{4 \times 03 = 12}$

(D) (i) Dipole Iduced dipole / Londanforce
(ii) H bond / Dipole - Dipole interaction / London force
(iii) Ion - dipole interaction / H bond / londanforce

$\boxed{8 \times 02 = 16}$

$\boxed{100}$

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2 (A) (i)
$NCl_3 + 3H_2O \longrightarrow NH_3 + HOCl$
$PCl_3 + 3H_2O \longrightarrow H_3PO_3 + 3HCl$
$AsCl_3 + 3H_2O \longrightarrow H_3AsO_3 + 3HCl$
$SbCl_3 + H_2O \rightleftharpoons SbOCl + 2HCl$
$BiCl_3 + H_2O \rightleftharpoons BiOCl + 2HCl$
$PCl_5 + H_2O \longrightarrow POCl_3 + 2HCl$

$6 \times 01 = 06$
$6 \times 03 = 18$

(ii) Bond angle $NCl_3 > PCl_3$,
Valance P orbital of N (2P) in NCl_3 molecule is closer to nucleous compared to that of P in PCl_3 (3P) Therefore it is more subjected to the nuclear attraction than in PCl_3 molecule and hence the Bond pair — Bond pair replusion is greater in NCl_3 compare to that in PCl_3. $\boxed{10}$

		H_2O	NH_3	Cl^-
(B) I	Cr^{3+}	$[Cr(H_2O)_6]^{3+}$	—	—
		Violet	—	—
II	Mn^{2+}	$[Mn(H_2O)_6]^{2+}$	—	$MnCl_4^{2-}$
		Pale Pink	—	Greenish Yellow

Date: ..../........../..........

III Ni^{2+} $[Ni(H_2O)_6]^{2+}$ $[Ni(NH_3)_6]^{2+}$ $[NiCl_4]^{2-}$

Green Blue yellow

IV Zn^{2+} $[Zn(H_2O)_6]^{2+}$ $[Zn(NH_3)_4]^{2+}$ $[ZnCl_4^{2-}]$

colourless colourless colourless

complex ion and dash $12 \times 02 = 24$

colour / dash $12 \times 01 = 12.$

(C) SO_2 Oxidizing agent reducing agent Possible answers

H_2S Oxidizing agent reducing agent Possible answers

NH_3 Oxidizing agent reducing agent Possible answers

$\boxed{6 \times 5 = 30}$

$\boxed{100}$

③ (a) (i) $HA_{(aq)} + NaOH_{(aq)} \longrightarrow NaA_{(aq)} + H_2O_{(l)}$

$n_{NaOH} = 0.1\ mol\,dm^{-3} \times 50\times10^{-3}\,dm^3$
$= 5\times10^{-3}\ mol$ -------- (03)

Since $HA : NaOH = 1:1$, $n_{HA} = 5\times10^{-3}\ mol$

$\therefore [HA] = \dfrac{5\times10^{-3}\ mol}{25\times10^{-3}\,dm^3} = 0.2\ mol\,dm^{-3}$ ----- (02)

(ii) Point P represents 50% neutralization.

$[HA] = [NaA]$ ------- (03)

Resulting solⁿ. is a buffer.

$pH = pK_a + \log\dfrac{[Salt]}{[Acid]}$ ---- (02)

$pH = pK_a = 5$

$K_a = 1\times10^{-5}\ mol\,dm^{-3}$ ---- (05)

(iii) pH at point A $= -\log_{10}\sqrt{cK_a} = -\log_{10}\sqrt{0.2\times1\times10^{-5}}$ ----- (03)

$= 3 - \log_{10}2$

$= 2.6990\ (\simeq 2.7)$ --- (02)

(iv) pH at equivalence point is determined by the hydrolysis of salt formed.

$A^-_{(aq)} + H_2O_{(l)} \rightleftharpoons HA_{(aq)} + OH^-_{(aq)}$ ----- (03)

Initial $[A^-_{(aq)}] = \dfrac{5\times10^{-3}\ mol}{75\times10^{-3}\,dm^3} = \dfrac{2}{30}\ mol\,dm^{-3}$ ----- (03)

$K_{b(A^-)} = \dfrac{K_w}{K_{a(HA)}} = \dfrac{1\times10^{-14}\ mol^2dm^{-6}}{1\times10^{-5}\ mol\,dm^{-3}}$ --- (02)

$= 1\times10^{-9}\ mol\,dm^{-3}$

$K_b = \dfrac{[HA_{(aq)}][OH^-_{(aq)}]}{[A^-_{(aq)}]} = \dfrac{[OH^-_{(aq)}]^2}{[A^-]}$ ---- (02)

$\therefore [OH^-_{(aq)}] = \sqrt{1\times10^{-9}\ mol\,dm^{-3}\times\frac{2}{30}\ mol\,dm^{-3}}$

$= \sqrt{\frac{2}{3}\times10^{-10}}\ mol\,dm^{-3}$ --- (02)

$pOH = 5 - \frac{1}{2}\log_{10}2 + \frac{1}{2}\log_{10}3$

$\therefore pH = 8.911$ -------- (03)

(V) Equivalence point: Volume of the titrant required to react in the stoichiometrically equivalent amount with the analyte --- 04

End point: The point at which we stop addin the titrant which is indicated by the change in the colour of a substance (an indicator) ----- 04

The end point is little in excess compared to the equivalence point, the difference being the titration error. --- 02

(VI) Y ----- 02 Because the colour change pH inter -val of Y entirely lies within the abrupt pH near the equivalence point ------ 03

(a) ⇒ 50

(b) (i) $n_{MgCO_3} = \frac{2.1\,g}{84\,g\,mol^{-1}} = 0.025\,mol$ ---- 02

$n_{HCl} = 4\,mol\,dm^{-3} \times 25 \times 10^{-3}\,dm^3 = 0.1\,mol$ ---- 02

Therefore, limiting reagent is $MgCO_3$. ---- 02

Heat energy liberated for 1 mol of $MgCO_3 = 40\,kJ$

$\therefore$ For $0.025\,mol\ MgCO_3 = \underline{1\,kJ}$ ---- 04

(ii) $Q = ms\Delta t$ ----- 02

$1000\,J = 25\,cm^3 \times 1.19\,g\,cm^{-3} \times 4.2\,J\,g^{-1}K^{-1} \times \Delta t$ 04 + 01 (subst., unit)

$\Rightarrow \Delta t = 8^\circ C$ ---- 03

(iii) $MgCO_{3(s)} + 2HCl_{(aq)} \xrightarrow{-40\,kJ\,mol^{-1}} MgCl_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$

$\Delta H_{f(MgCO_{3(s)})}$ $\qquad$ $(-393-286)\,kJ\,mol^{-1}$

$C_{(s/gra.)} + \frac{3}{2}O_{2(g)} + Mg_{(s)} + 2HCl_{(aq)} \xrightarrow{-470\,kJ\,mol^{-1}} MgCl_{2(aq)} + H_{2(g)} + \frac{3}{2}O_{2(g)} + C$

For cycle → 05

By using Hess's law,

$\Delta H_{f(MgCO_3)} - 40\ kJmol^{-1} = -470\ kJmol^{-1} - 393\ kJmol^{-1} - 286\ kJmol^{-1}$ ---- 02

$\therefore \Rightarrow \Delta H_{f(MgCO_3)} = -1109\ kJmol^{-1}$ ---- 03

(iv) $2HCl_{(aq)} + Mg_{(s)} + ZnCl_{2(aq)} \xrightarrow{\Delta H_R} MgCl_{2(aq)} + Zn_{(s)} + 2HCl_{(aq)}$

$-470\ kJmol^{-1}$ ↘ ↙ $-270\ kJmol^{-1}$

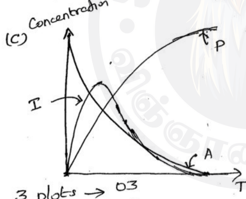
$ZnCl_{2(aq)} + MgCl_{2(aq)} + H_{2(g)}$ For cycle → 05

Hess's law,

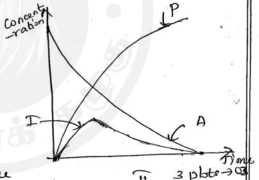
$-470\ kJmol^{-1} = \Delta H_R - 270\ kJmol^{-1}$ ---- 02

$\Delta H_R = -200\ kJmol^{-1}$ ---- 03

(C)



3 plots → 03
labelling → 02
I



II 3 plots → 03
labelling 02

(B) ⇒ 50

4 (30)

(a) (i)

P: $HC \equiv C - \underset{\displaystyle OH}{\underset{|}{CH}} - CH = C \begin{smallmatrix} CH_2OH \\ H \end{smallmatrix}$

Q: $CH_3 - CH_2 \underset{\displaystyle OH}{\underset{|}{CH}} - CH_2 - CH_2 - CH_2OH$

(+)

R : $CH_3CH_2-\overset{O}{\overset{||}{C}}-CH_2CH_2COOH$

S : $CH_3CH_2CH_2CH_2CH_2COOH$

T : $CH_3CH_2-\overset{O}{\overset{||}{C}}-CH_2CH_2COCl$

U : $CH_3CH_2-\underset{CH_3}{\underset{|}{\overset{OH}{\overset{|}{C}}}}-CH_2CH_2-\underset{CH_3}{\underset{|}{\overset{OH}{\overset{|}{C}}}}-CH_3$

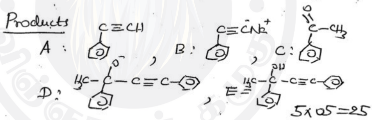
$6 \times 05 = 30$

(b) (ii) Reagents | Type of mechanism

Reagents	Type of mechanism
a ⇒ alc. KOH	elimination
b ⇒ $NaNH_2$	———
c ⇒ dil H_2SO_4, $Hg^{2+}_{(aq)}$ Δ	———
f ⇒ PBr_3 / HBr	nucleophilic addition nucleophilic subst.

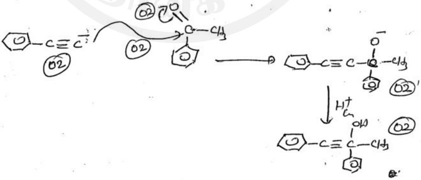
$4 \times 05 = 20$ $\quad$ $3 \times 05 = 15$

Products



$5 \times 05 = 25$

(iii)



Part II B

5 (A) (i) [10]

$$Ag_2CrO_{4(s)} \rightleftharpoons 2Ag^+_{(aq)} + CrO^{2-}_{4(aq)} \text{ ------ } 02$$

According to equilibrium law, ---- 02

$$K = \frac{[Ag^+_{(aq)}]^2[CrO^{2-}_{4(aq)}]}{[Ag_2CrO_{4(s)}]} \text{ ------ } 02$$

since Ag_2CrO_4 is a sparingly soluble solid

$$[Ag_2CrO_{4(s)}] = \text{constant} \text{ --- } 02$$

$$\therefore [Ag^+_{(aq)}]^2[CrO^{2-}_4] = K[Ag_2CrO_{4(s)}] = \text{Const} = K_{sp} \text{ --- } 02$$

(ii) [10]

$$Ag_2CrO_{4(s)} \rightleftharpoons 2Ag^+_{(aq)} + CrO^{2-}_{4(aq)}$$

equilibrium concentration $\quad 2\times10^{-4}\, mol\, dm^{-3} \quad 1\times10^{-4}\, mol\, dm^{-3}$ --- 02

$$K_{sp} = [Ag^+_{(aq)}]^2[CrO^{2-}_{4(aq)}] \text{ --- } 03$$

$$= (2\times10^{-4}\, mol\, dm^{-3})^2(1\times10^{-4}\, mol\, dm^{-3}) \text{ --- } 02$$

$$= 4\times10^{-12}\, mol^3 dm^{-9} \text{ ---- } 03$$

(iii) [10] maximum mass of Ag_2CrO_4 that can dissolve in 100 cm^3 of water

$$= 1\times10^{-4}\, mol\, dm^{-3} \times 0.1\, dm^3 \times 332\, g\, mol^{-1} \text{ ---- } 05$$

$$= 332\times10^{-5}\, g = 3.32\, mg \text{ --- } 05$$

(iv) [15]

$$[CrO^{2-}_{4(aq)}] = \frac{2\, mol\, dm^{-3}\times 250\, cm^3}{500\, cm^3} = 1\, mol\, dm^{-3} \text{ ---- } 05$$

$$[Ag^+_{(aq)}] = \left\{\frac{K_{sp}}{[CrO^{2-}_4]}\right\}^{\frac{1}{2}}$$

$$= \left(\frac{4\times10^{-12}\, mol^3 dm^{-9}}{1\, mol\, dm^{-3}}\right)^{\frac{1}{2}} = 2\times10^{-6}\, mol\, dm^{-3} \text{ ---- } 05$$

Moles of Ag_2CrO_4 precipitated

$$= (2\times10^{-4} - 2\times10^{-6})\frac{500}{1000}\, mol$$

$$\approx 1\times10^{-4}\, mol \text{ ------ } 05$$

(V) In a saturated sol^n of Ag_2CrO_4, the following equilibrium exists:
15

$$Ag_2CrO_{4(s)} \rightleftharpoons 2Ag^+_{(aq)} + CrO^{2-}_{4(aq)} \quad \text{---} ① \quad 05$$

when $NH_{3(aq)}$ is added, another equilibrium

$$Ag^+_{(aq)} + 2NH_{3(aq)} \rightleftharpoons [Ag(NH_3)_2]^+$$ reaches --- ② 05

$Ag^+_{(aq)}$ ion concentration decreases and therefore according to Le-Chatelier's principle, reaction ① gets shifted towards right causing $[CrO_4^{2-}]$ to increase. --- 05

(A) ⇒ 60

(B) (i) $P_A = 1.2 \times 10^5\ Pa \times \frac{3}{4} = 9 \times 10^4\ Pa$ ---- 05
15
$P_B = 1.2 \times 10^5\ Pa \times \frac{1}{4} = 3 \times 10^4\ Pa$ ---- 05

For gaseous phase, $PV = nRT$

$$n = \frac{PV}{RT} = \frac{1.2 \times 10^5\ Pa \times 8.314 \times 10^{-3}\ m^3}{8.314\ J\,mol^{-1}K^{-1} \times 300\ K}$$

$= 0.4\ mol$ ---- 05

(ii) gaseous phase,
10

$$n_A^v = \frac{P_A}{P_{Tot}} \times n_{Tot}$$
$$= \frac{3}{4} \times 0.4\ mol = 0.3\ mol \ \text{---}\ 03$$

$$n_B^v = \frac{P_B}{P_{Tot}} \times n_{Tot} = 0.1\ mol \ \text{----}\ 03$$

liquid phase,

$$n_A^l = (1 - 0.3)\ mol = 0.7\ mol \ \text{---}\ 02$$
$$n_B^l = (1 - 0.1)\ mol = 0.9\ mol \ \text{---}\ 02$$

(iii) According to Raoult's law, ---- 05
15

$$P_A = X_A P_A^\circ$$
$$P_A^\circ = \frac{P_A}{X_A} = \frac{9 \times 10^4\ Pa}{0.7/1.6} = 20.57 \times 10^4\ Pa \ \text{----}\ 05$$

$$P_B^\circ = \frac{P_B}{X_B} = \frac{3 \times 10^4\ Pa}{0.9/1.6} = 5.33 \times 10^4\ Pa \ \text{---}\ 05$$

(B) ⇒ 40

(c) When $H_2S_{(g)}$ is passed through the solution, the following equilibria exist

$$H_2S_{(g)} \rightleftharpoons H_2S_{(aq)}$$

$$H_2S_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + HS^-_{(aq)} \; ; \; K_{a_1} = \frac{[H_3O^+_{(aq)}][HS^-]}{[H_2S_{(aq)}]} \text{ --- (03)}$$

$$HS^-_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + S^{2-}_{(aq)} \; ; \; K_{a_2} = \frac{[H_3O^+_{(aq)}][S^{2-}_{(aq)}]}{[HS^-_{(aq)}]} \text{ --- (03)}$$

$$\therefore K_{a_1} \times K_{a_2} = \frac{[H_3O^+_{(aq)}]^2[S^{2-}_{(aq)}]}{[H_2S]} = (9.1 \times 10^{-8})(1 \times 10^{-19})$$

$$\Rightarrow [H_3O^+_{(aq)}]^2[S^{2-}_{(aq)}] = 9.1 \times 10^{-28} \, mol^3 dm^{-9} \text{ --- (04)}$$

Minimum $[S^{2-}_{(aq)}]$ required for precipitating ZnS

$$[S^{2-}_{(aq)}] = \frac{K_{sp}(ZnS)}{[Zn^{2+}_{(aq)}]} = \frac{1.6 \times 10^{-24} \, mol^2 dm^{-6}}{0.1 \, mol \, dm^{-3}} \text{ --- (02)}$$

$$= 1.6 \times 10^{-23} \, mol \, dm^{-3} \text{ (03)}$$

Corresponding to this minimum concentration of S^{2-}, maximum concentration of H_3O^+ may be calculated using

$$[H_3O^+_{(aq)}]^2[S^{2-}_{(aq)}] = 9.1 \times 10^{-28} \, mol^3 dm^{-9}$$

$$[H_3O^+_{(aq)}]^2 = \frac{9.1 \times 10^{-28}}{1.6 \times 10^{-23}} \doteq 5.7 \times 10^{-5} \, mol^2 dm^{-6} \text{ --- (05)}$$

$$\therefore [H_3O^+_{(aq)}] = 7.6 \times 10^{-3} \, mol \, dm^{-3} \text{ (02)}$$

$$pH = -\log[H_3O^+_{(aq)}] = 3 - \log 7.6$$

$$= 2.1 \text{ --- (03)}$$

Similarly, minimum $[S^{2-}_{(aq)}]$ required for precipitating FeS

$$[S^{2-}_{(aq)}] = \frac{K_{sp}(FeS)}{[Fe^{2+}_{(aq)}]} = \frac{6.3 \times 10^{-18} \, mol^2 dm^{-6}}{0.1 \, mol \, dm^{-3}}$$

$$= 6.3 \times 10^{-17} \, mol \, dm^{-3} \text{ --- (02)}$$

maximum concentration of H_3O^+ may be calculated using (03)

$$[H_3O^+_{(aq)}][S^{2-}_{(aq)}] = 9.1 \times 10^{-28} \, mol^3 dm^{-9} \text{ ---}$$

$$[H_3O^+]^2 = \frac{9.1 \times 10^{-28}}{6.3 \times 10^{-17}} \, mol^2 dm^{-6}$$

$[H_3O^+_{(aq)}] = 3.7 \times 10^{-6}\ mol\ dm^{-3}$ --- 05

$pH = -\log[H_3O^+_{a}] = 6 - \log 3.7$

$= 5.4$ ----- 05

∴ The pH of the solution ~~is~~ to separate the two ions should be between ~~2.1 and~~ 2.1 and 5.4. ------ 10

(c) ⇒ 50

---

6 (a) (i) $[B]_0 = \frac{0.4 \times 200}{1000}\ mol\ dm^{-3}$

80 25

$= 0.08\ mol\ dm^{-3}$ ------ 05

$[B]_{t=12} = 0.032\ mol\ dm^{-3}$

Rate of consumption of $B = -\frac{\Delta[B]}{\Delta t}$

$= \frac{(0.08 - 0.032)\ mol\ dm^{-3}}{12\ s}$ ---- 05

$= 4 \times 10^{-3}\ mol\ dm^{-3} s^{-1}$ --- 05

Rate of consumption of A

$= 8 \times 10^{-3}\ mol\ dm^{-3} s^{-1}$ --- 05

Rate of formation of D

$= 12 \times 10^{-3}\ mol\ dm^{-3} s^{-1}$ --- 05

(ii) Considering the change in concentration of

20 [A] $0.4\,M \xrightarrow[t_{\frac{1}{2}} = 120s]{} 0.2\,M$, $0.2\,M \xrightarrow[t_{\frac{1}{2}} = 60s]{} 0.1\,M$,

$0.1\,M \xrightarrow[t_{\frac{1}{2}} = 30s]{} 0.05\,M$

It follows that

$t_{\frac{1}{2}} \propto [A]_0$ --- 05

∴ order w.r.t A is zero. --- 05

Since the unit of rate constant is s^{-1}, overall order should be one. --- 05

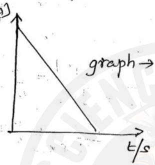
∴ Order w.r.t B must be one --- (05)

12 (iii) (I) $t_{\frac{1}{2}} = \frac{0.693}{k} = \frac{0.693}{3.3 \times 10^{-3} s^{-1}}$ ---- (05)

$= 210\ s$ ------ (05)

(II) $100 \times \left(\frac{1}{2}\right)^3 = 12.5\%$ ---- (02)

23 (iv) (I)



graph → (03)

(II) Initial rate,

$R = k[B]$

$= 3.3 \times 10^{-3} s^{-1} \times 0.4\ mol\ dm^{-3}$ ---- (05)

$= 1.32 \times 10^{-3}\ mol\ dm^{-3} s^{-1}$

Rate must be constant (02) throughout the expt. ---- (03)

(III) As [B] is constant, at the end of the reaction [A] must be zero.

$-\frac{1}{2}\frac{\Delta[A]}{\Delta t} = R$ ---- (02)

$-\frac{1}{2}\frac{[0 - 0.4]\ mol\ dm^{-3}}{\Delta t} = 1.32 \times 10^{-3}\ mol\ dm^{-3} s^{-1}$ ---- (05)

$\Rightarrow \Delta t = 151.5\ s$ ---- (03) (A) ⇒ 70

30 (b) 05 (i) Definition of buffer sol^n ----- (05)

15 (ii) $NH_{3(aq)} + H_2O_{(l)} \rightleftharpoons NH^+_{4(aq)} + OH^-_{(aq)}$ ---- (02)

$K_b = \frac{[NH^+_{4(aq)}][OH^-_{(aq)}]}{[NH_{3(aq)}]} = 1.8 \times 10^{-5}\ mol\ dm^{-3}$ --- (02)

Since pH = 9, $[OH^-_{(aq)}] = 1 \times 10^{-5}\ mol\ dm^{-3}$ --- (02)

$[NH^+_{4(aq)}] = \frac{1.8 \times 10^{-5}\ mol\ dm^{-3} \times 0.1\ mol\ dm^{-3}}{1 \times 10^{-5}\ mol\ dm^{-3}}$

$= 0.18\ mol\ dm^{-3}$ (02)

Number of moles of NH_4^+ = $0.1\ mol\ dm^{-3} \times 1\ dm^3$

$= 0.18\ mol$ ---- (02)

Mass of NH_4Cl = $0.18\ mol \times 53.5\ g\ mol^{-1}$ ---- (03)

$= 9.63\ g$ ---- (02)

(iii) $NH_4Cl_{(aq)} \longrightarrow NH^+_{4(aq)} + Cl^-_{(aq)}$

(10) $NH^+_{4(aq)} + H_2O_{(l)} \rightleftharpoons NH_{3(aq)} + H_3O^+_{(aq)}$ ---- (02)

	$NH^+_{4(aq)}$	$NH_{3(aq)}$	$H_3O^+_{(aq)}$	
Initial concent:	0.5	-	-	$mol\ dm^{-3}$
Change in con:	$-x$	$+x$	$+x$	$mol\ dm^{-3}$
Eq^m. concen:	$0.5-x$	x	x	

$$K_a = \frac{[NH_{3(aq)}][H_3O^+]}{[NH_4^+]} = \frac{x^2}{0.5-x} \text{ ---- (03)}$$

$$K_{a(NH_4^+)} = \frac{K_w}{K_{b(NH_3)}} = \frac{1\times10^{-14}\ mol^2dm^{-6}}{1.8\times10^{-5}\ mol\ dm^{-3}}$$ ---- (02)

$$= 5.6\times10^{-10}\ mol\ dm^{-3}$$

$$\Rightarrow 5.6\times10^{-10}\ mol\ dm^{-3} = \frac{x^2}{0.5\ mol\ dm^{-3}}$$

$$x = [H_3O^+_{(aq)}] = 1.673\times10^{-5}\ mol\ dm^{-3}$$

$$pH = 5 - \log 1.673 \text{ ---- (03)}$$

(b) ⇒ 30

(c)

(i) $$K_c = \frac{[Y_{(g)}][Z_{(g)}]}{[X]_{(g)}} \text{ ---- (05)}$$

$$= \frac{(0.4\ mol\ dm^{-3})^2}{0.2\ mol\ dm^{-3}} = 0.8\ mol\ dm^{-3} \text{ ---- (05)}$$

---- (05)

(ii) Since P is halved, concentrations also become half.

At the moment, $Q_c = \frac{0.2\times0.2}{0.1}\ mol\ dm^{-3}$

$= 0.4\ mol\ dm^{-3}$

---- (05)

Since $Q_c < K_c$, the reaction proceed in the forward direction. --- 05

(ii) $X_{(g)} \rightleftharpoons Y_{(g)} + Z_{(g)}$

new initial concent.: 0.1 0.2 0.2 .. $mol\,dm^{-3}$

concent^n at new eq^m: $(0.1-x)$ $(0.2+x)$ $(0.2+x)$ --- 05

$$K_c = \frac{[Y][Z]}{[X]} = \frac{(0.2+x)^2}{0.1-x} \text{ --- } 05$$

$\Rightarrow x = 0.034$ mol --- 05

$\therefore [X] = (0.1-0.034)\,mol\,dm^{-3} = 0.066\,mol\,dm^{-3}$

$[Y] = 0.234\,mol\,dm^{-3}$ 2x05 = 10

(C) ⇒ 40

7 (a) (i) $HCl_{(aq)}$ ---- ~~05~~ 10

100

(ii) cathode : $Pt_{(s)} / Cl_{2(g)} / Cl^-_{(aq)}$ or Cl_2 electrode --- 10

anode : $Ag_{(s)} / AgCl_{(s)} / Cl^-_{(aq)}$ or silver-silverchloride electrode ---- 10

(iii) $Ag_{(s)} / AgCl_{(s)} / Cl^-_{(aq)} \,\vdots\vdots\, Cl^-_{(aq)} / Cl_{2(g)} / Pt_{(s)}$ --- 10

(iv) cathode: $Cl_{2(g)} + 2e \longrightarrow 2Cl^-_{(aq)}$

anode: $Ag_{(s)} + Cl^-_{(aq)} \longrightarrow AgCl_{(s)} + e$ } 2x05 = 10

(v) $2Ag_{(s)} + Cl_{2(g)} \longrightarrow 2AgCl_{(s)}$ --- 10

(vi) $E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ --- 05

$= 1.36\,V - 0.26\,V$ --- 05

$= 1.10\,V$ --- 05

(vii) $\Delta G^\theta = -nFE^\theta$

$= -2\,mol \times 96{,}500\,C\,mol^{-1} \times 1.10\,V$ --- 10

$= -212.3\,kJ\,mol^{-1}$ --- 05

(viii) E_{cell} remains unchanged --- 10

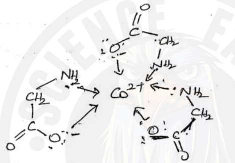
(b) (i) 50 Since the aqueous sol^n of the compound does not give a precipitate with $BaCl_{2(aq)}$, SO_4^{2-} cannot be the anion. ---- (10)

As it gives ppt. with $AgNO_3$, Cl^- must be the anion. ---- (10)

$\therefore$ The structural formula is

$[Co(NH_3)_4SO_4]Cl$ ---- (15)

(ii)



------ (15)

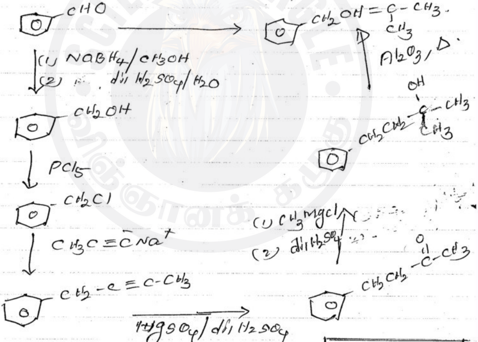
Part C

(8) (A)

R_1 Hg^{2+} / dil H_2SO_4	P_1 CH_3CHO
R_2 dil NaOH (aq)	P_2 $CH_3CH(OH)CH_2CHO$
R_3 I_2 / Δ	P_3 $CH_3CH=CHCHO$
R_4 H_2 / Ni, Δ	P_4 $CH_3CH_2CH_2CHO$
R_5 H_2 / Pd / $BaSO_4$, Quinoline	P_5 $CH_2=CH_2$
R_6 HCl (g)	P_6 CH_3CH_2Cl
R_7 Conc NH_3	P_7 $CH_3CH_2NH_2$

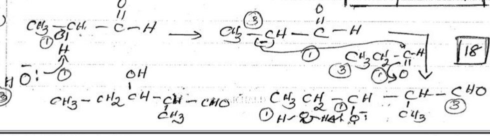
$\boxed{14 \times 5 = 70}$

(B)



$\boxed{11 \times 4 = 44}$

(C)



$\boxed{18}$

(ii) Self condenzation Reaction. $\boxed{4}$

(iii) Basic Property $CH_3CH_2\overset{O}{\overset{\|}{C}}-NH_2 < CH_3CH_2CH_2NH_2$

$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-\ddot{N}H_2 \longleftrightarrow CH_3CH_2-\overset{O^-}{C}=\overset{+}{N}H_2$ (8)

due to This resonance ability of donation of lone pair electron of Nitrogen is reduced. (6)

$\boxed{14}$

$\boxed{150}$

---

(9)(A) (a) $n_{BaSO_4} = \dfrac{4.670\,g}{233\,g\,mol^{-1}} = 0.02\,mol$ (4) (4)

$n_{SO_4^{2-}} = 0.02\,mol$ (4)

$C_{SO_4^{2-}} = \dfrac{0.02\,mol}{50\times10^{-3}\,dm^3} = 0.4\,mol\,dm^{-3}$ (4) (4)

$\boxed{20}$

(b) $5Fe^{2+} + MnO_4^- + 8H^+ \longrightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$ (7)

$5CuS + 6MnO_4^- + 28H^+ \longrightarrow 6Mn^{2+} + 5Cu^{2+} + 5SO_2 + 14H_2O$ (7)

$n_{Fe^{2+}} = 0.2\,mol\,dm^{-3} \times 11.00\times10^{-3}\,dm^3$ 2+1

$= 2.2\times10^{-3}\,mol$ 2+1

$n_{remaining\ MnO_4^-} = \frac{1}{5}\times 2.2\times10^{-3}\,mol$ 2+1

$= 0.44\times10^{-3}\,mol$ 2+1

$n_{initial\ MnO_4^-} = 0.56\,mol\,dm^{-3} \times 30\times10^{-3}\,dm^3$ 2+1

$= 16.8\times10^{-3}\,mol$ 2+1

Moles of MnO_4^- reacted with CuS $= (16.8\times10^{-3} - 0.44\times10^{-3})\,mol$

$= 16.36\times10^{-3}\,mol$ 2+1

$$n_{CuS} = \frac{5}{6} \times 16.36 \times 10^{-3} \text{ mol} = 13.63 \times 10^{-3} \text{ mol}$$
2+1 2+1

$$n_{Cu^{2+}} = 13.63 \times 10^{-3} \text{ mol}$$ 2+1

$$C_{Cu^{2+}} = \frac{13.63 \times 10^{-3} \text{ mol}}{50 \times 10^{-3} \text{ dm}^3} = 0.273 \text{ mol dm}^{-3}$$
2+1 2+1

$\boxed{50}$

(C) $IO_3^- + 5I^- + 6H^+ \longrightarrow 3I_2 + 3H_2O$ (3)

$I_2 + 2S_2O_3^{2-} \longrightarrow 2I^- + S_4O_6^{2-}$ × 3 (3)

$IO_3^- + 6S_2O_3^{2-} + 6H^+ \longrightarrow I^- + 3S_4O_6^{2-} + 3H_2O$ (4)

$$n_{S_2O_3^{2-}} = 0.6 \text{ mol dm}^{-3} \times 40 \times 10^{-3} \text{ dm}^3$$ 3+1
$$= 24 \times 10^{-3} \text{ mol}$$ 3+1

$$n_{H^+} \text{ in } 50 \text{ cm}^3 = 24 \times 10^{-3} \text{ mol}$$ 3+1

$$C_{H^+} = \frac{24 \times 10^{-3} \text{ mol}}{50 \times 10^{-3} \text{ dm}^3} = 0.48 \text{ mol dm}^{-3}$$
3+1 3+1

$\boxed{30}$

100

(B) X = H_2S , Z = SO_2 10 × 2 = 20

(ii) Y = S 10

(iii) $2KMnO_4 + 3H_2SO_4 + 5H_2S \longrightarrow K_2SO_4(aq) + 5S\downarrow + 2MnSO_4 + 8H_2O$

Ionic equation also acceptable.

$H_2S + \text{conc } H_2SO_4 \longrightarrow S + SO_2 + 2H_2O$

$H_2S + SO_2 \longrightarrow 3S\downarrow + 2H_2O$ $\boxed{5 \times 3 = 15}$

iv Crown shape (5)

$\boxed{50}$

$\boxed{150}$

10 (A) i) Y - CuS , Z - $CuCl_4^{2-}$, P - MnS
Q - $MnCl_4^{2-}$, R - $SrCO_3$ $\boxed{5 \times 07 = 35}$

(ii) Cu^{2+}, Mn^{2+}, Sr^{2+} $\boxed{8 \times 3 = 24}$

(iii) $Mn(OH)_2 \downarrow$ (6) white or cream Colour (5)

$\boxed{70}$

(B) A - $[Cr(H_2O)_6]^{3+}$ P - $Cr(OH)_3$.

B - $[Fe(H_2O)_6]^{3+}$ Q - $Fe(OH)_3$.

C - $[Co(H_2O)_6]^{2+}$ R - $[Co(NH_3)_6]^{3+}$

D - $[Mn(H_2O)_6]^{2+}$ S - $Mn(OH)_2$

$\boxed{8 \times 05 = 40}$

C (i) Potassium pentaamminecyanidomanganese(II)
hexaamminenickel(II) chloride

$5 \times 2 = 10$

(ii)

MnO	+2	base
Mn_2O_3	+3	weak base
MnO_2	+4	amphoteric
MnO_3	+6	weak acid
Mn_2O_7	+7	acid

$\boxed{15 \times 02 = 30}$

$\boxed{150}$