இலங்கையின் உயர்தர கணித விஞ்ஞான

பிரிவிற்கான இணையதளம்

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F.W.C Exam March 2017

Grade 13 (2017) Chemistry

Marking Scheme

Part I

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

Part II A - Structured Essay

Q.① (a) (i) $OH^- < CH_3O^- < CH_3C\equiv C^- < NH_2^-$

(ii) $NH_3 < NH_4^+ < NO_3^- < NO_2^+$

(iii) $He < N_2 < CO_2 < NH_3$

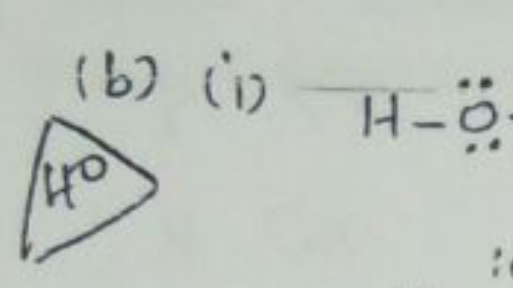
(iv) $Al(OH)_3 < Mg(OH)_2 < Ba(OH)_2 < KOH$

(v) $BaF_2 < BaCl_2 < CaCl_2 < MgBr_2$

(vi) $H_2O_2 < conc.H_2SO_4 < Cl_2 < MnO_2$

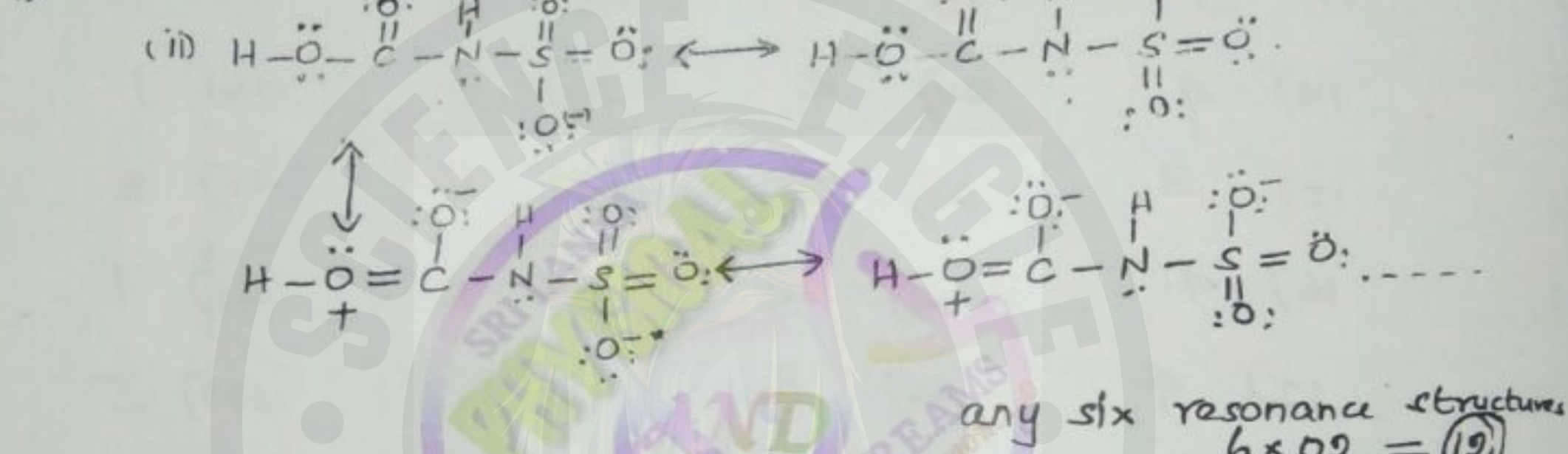
$6 \times 04 = (24)$

(b) (i)



(06)

(ii)



any six resonance structures

$6 \times 02 = (12)$

(iii)

		$O_{(1)}$	C	N	S
(I)	Electron pair geometry	Tetrahedral	Trigonal planar	Tetrahedral	Tetrahedral
(II)	Shape	Angular	Trigonal planar	Trigonal pyramidal	Tetrahedral
(III)	Hybridization	sp^3	sp^2	sp^3	sp^3
(IV)	Bond angle	$\simeq 109^\circ$	$\simeq 120^\circ$	$\simeq 107^\circ$	$\simeq 109^\circ$

$16 \times 01 = (16)$

(iv) N – S : N $\underline{sp^3}$ S $\underline{sp^3}$

C – $O_{(2)}$: C $\underline{sp^2}$ O $\underline{2p}$

$O_{(1)}$ – H : $O_{(1)}$ $\underline{sp^3}$ H $\underline{1s}$

$6 \times 01 = (06)$

(36)

(i) False ..... (03)

(06)
- Cation is the same
- anionic size $O^{2-} < N^{3-}$
- charge $N^{3-} > O^{2-}$
- ∴ Polarizability of $N^{3-} > O^{2-}$
- Covalent character $Li_3N > Li_2O$

(ii) True --- (03)

Since size of the cation increases while charge remains the same, charge density decreases ∴ Hydration energy decreases. (06)

(iii) True :- → (03)

Both have London forces as the secondary interaction. Because of the larger size of Xe, it has stronger London forces than CH_4. } (06)

(iv) False ---- (03)

Although repulsion units are equal, number of lone pairs and bond pairs are different.
Repulsion among them is different. } (06)

Q (2) (a)

(i) A = Li , B = Be ---- 2 × 05 = (10)

(ii) C = LiOH , D = H_2 ---- 2 × 05 = (10)

(iii) Li_3N , Li_2O ---- 2 × 02 = (04)

$6Li + N_2 \longrightarrow 2Li_3N$

$4Li + O_2 \longrightarrow 2Li_2O$ } 2 × 03 = (06)

(iv) Z = NH_3 ---- (03)

(v) (I) Atomic size A > B

(II) 2nd I.E A > B

(III) m.p. B > A } 3 × 04 = (12)

(b) (i) M = Cu (01) (ii) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$ (04)

(i) P = Cl_2 , X = CuCl / Cu_2Cl_2 , Y = $CuCl_2$, Q = NH_3 , T = HCl

5 × 02 = (10)

(ii) $NCl_3 + 3H_2O \longrightarrow NH_3 + 3HOCl$ ---- (05)

(v) HOCl is less stable and decomposes to give Cl_2 which can bleach

$4HOCl_{(aq)} \longrightarrow 2Cl_{2(aq)} + O_{2(g)} + 2H_2O_{(l)}$ } (05)

(vi) $2NH_3 + 3Cl_2 \longrightarrow N_2 + 6HCl$

(excess) $NH_3 + 3Cl_2 \longrightarrow NCl_3 + 3HCl$

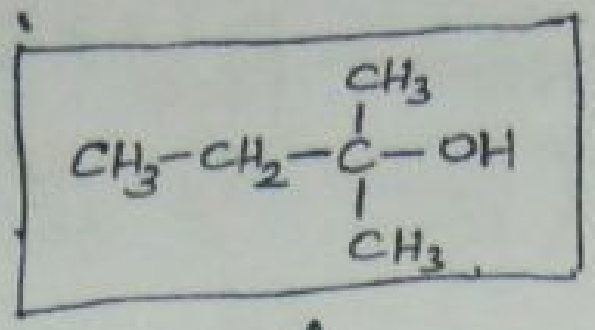
$8NH_3 + 3Cl_2$ (excess) $\longrightarrow N_2 + 6NH_4Cl$ } 3 × 03 = (09)

3 × 02 = (06)

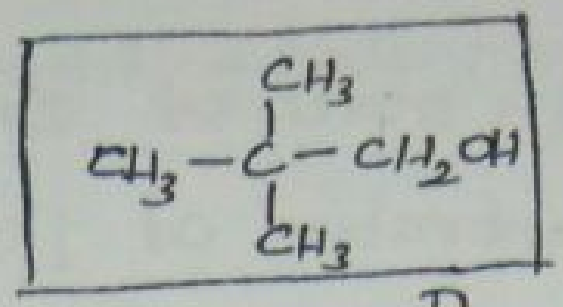
(c) (i) $CuSO_4$ (ii) $Na_2S_2O_3$ (iii) KBr (iv) PCl_5 (v) AlN

5 × 04 = (20)

7 (a) (i) (35)

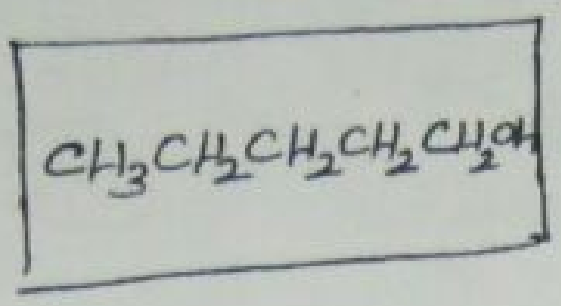


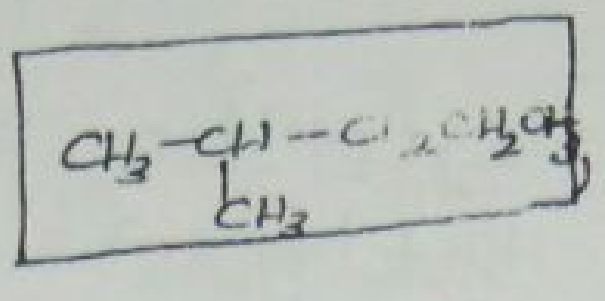
A



D

(ii)





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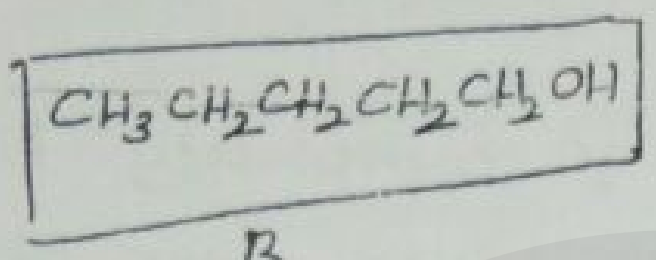
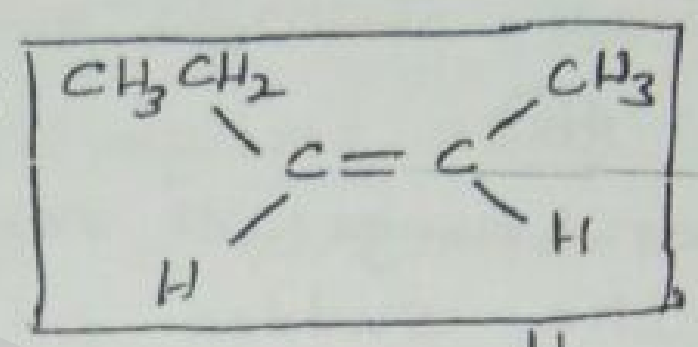


B

(iv)

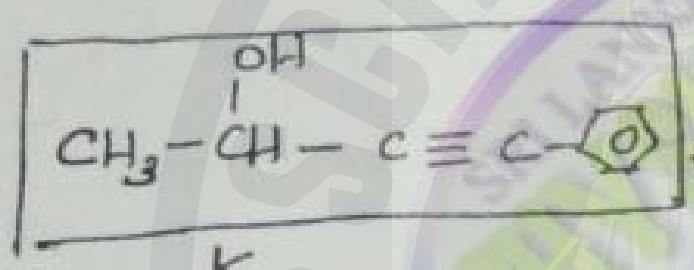


6×05 = 30

(v) Geometrical isomerism / cis-trans isomerism ---- (02)

(vi) pent.-2-ene or 2-pentene ---- (03)

(b) (40)



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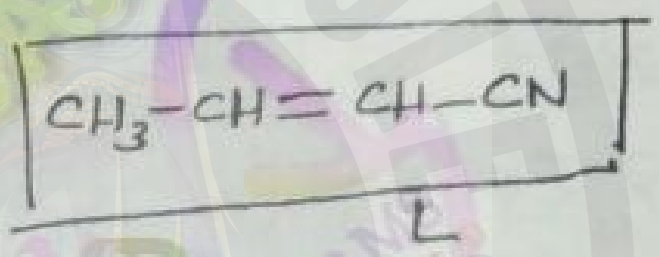
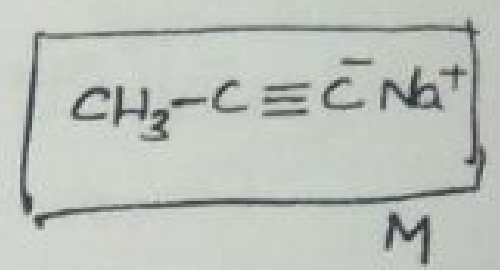


L



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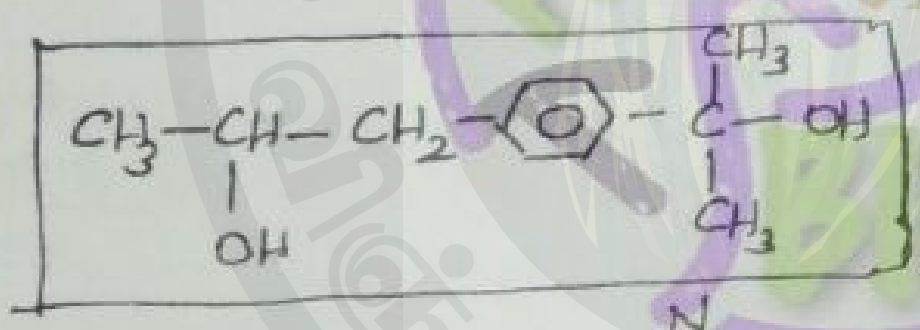

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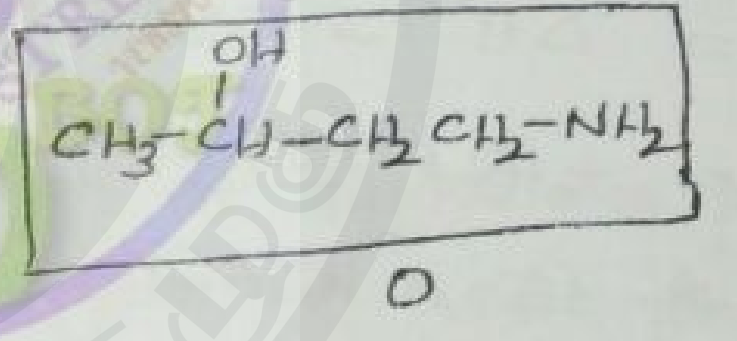
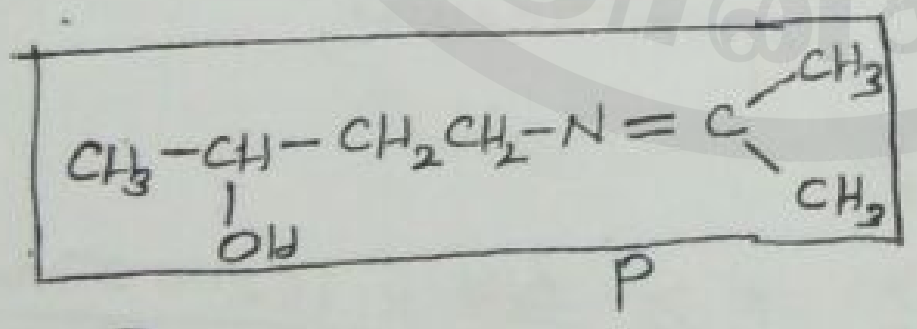


O



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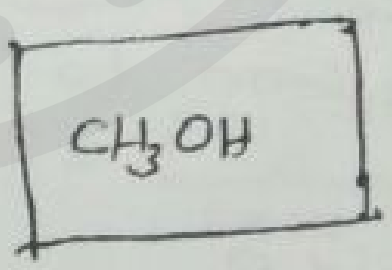
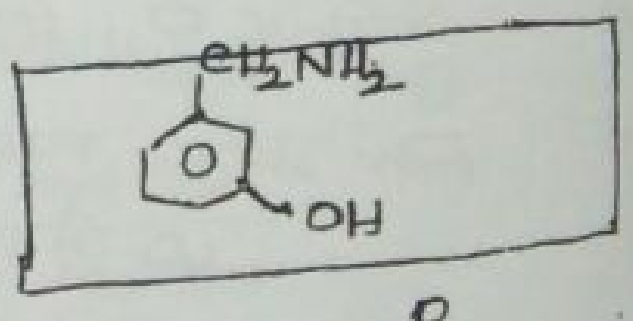


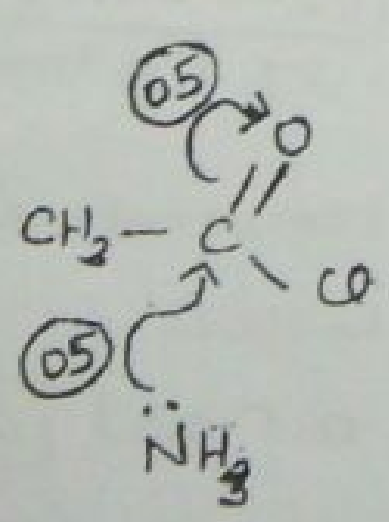
Q

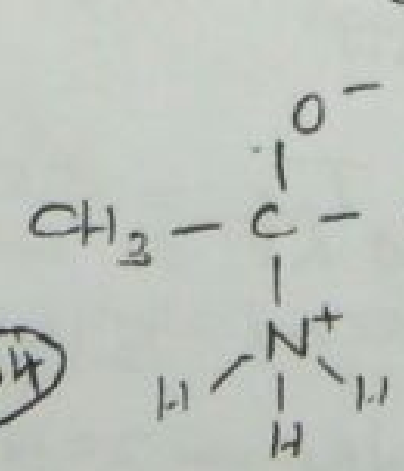


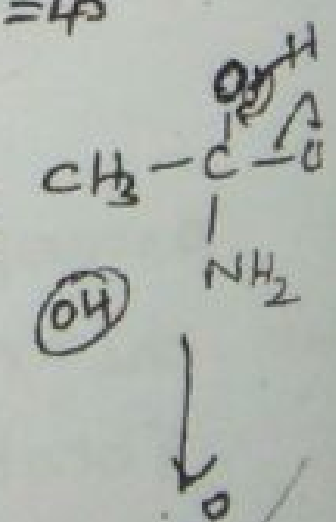
R

8×05 = 40

(c) (25)







Type of the mechanism:

Nucleophilic addition (followed by elimination) (05)

nt c : Amt. in moles of excess NaOH = $\frac{0.1 \times 25}{1000}$ mol

Concentration of $[OH^-] = \left(\frac{0.1 \times 25}{1000}\right) \frac{1000}{75}$ mol dm^{-3}

$pOH = -\log[OH^-] = \frac{0.1}{3} = 3.3 \times 10^{-2}$ mol dm^{-3}

$pH = 12 + \log_{10} 3.3 = 12.519$ ---- (05)

(iii) y ---- (02)

The colour change pH range of y completely lies within the sudden pH increase range near the end point. (03)

(i) $\Delta S^{\ominus} = \sum S^{\ominus}_{Products} - \sum S^{\ominus}_{Reactants}$ (02)

$= [(3 \times 134) + 93] J mol^{-1} k^{-1} - 4 \times 112 J mol^{-1} k^{-1}$ (03)

$= +37 J k^{-1} mol^{-1}$ --- (05)

(ii) $\Delta G^{\ominus} = \Delta H^{\ominus} - T\Delta S^{\ominus}$ - (02)

$= +16.8 kJ mol^{-1} - 298 K \times 0.037 kJ mol^{-1} k^{-1}$ (03)

$= 5.8 kJ mol^{-1}$ (05)

(iii) $\Delta G < 0$ (05)

(iv) For the reaction to be spontaneous,

$\Delta G \leq 0$

$\Delta H - T\Delta S \leq 0$

$T\Delta S \geq \Delta H$ $\therefore T \geq \frac{\Delta H}{\Delta S} = \frac{16800 J mol^{-1}}{37 J k^{-1} mol^{-1}}$

$T_{min} = 454 k.$ (05)

Assumption : ΔH and ΔS do not vary with temperature (05)

Let the no. of moles of $C_4H_{6(g)}$ be x.

Total no. of moles = $\frac{11.2 dm^3}{22.4 dm^3 mol^{-1}} = 0.5$ mol (05)

950 kJ = x mol x 1560 $kJ mol^{-1}$ + (0.5 − x) mol x 2240 $kJ mol^{-1}$ (05)

$\Rightarrow x = 0.25$ mol --- (02)

Mass of C_4H_8 = 0.25 mol x 42 g mol^{-1} = 10.5 g

Mass of C_6H_6 = 0.25 mol x 78 g mol^{-1} = 19.5 g

% of C_4H_8 = $\frac{10.5}{30} \times 100\%$ = 35% --- (04)

% of C_6H_6 = 65% --- (04)

Q(3) (a) (i) pH of CH_3COOH (before adding NaOH) = 3

(45)

$$-\log_{10}[H_3O^+_{(aq)}] = 3$$

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

$$\sqrt{ck_a} = [H_3O^+_{(aq)}]$$

$$c = \frac{[H_3O^+_{(aq)}]^2}{K_a} = \frac{10^{-6}\ mol^2\ dm^{-6}}{1\times10^{-5}\ mol\ dm^{-3}} = 0.1\ mol\ dm^{-3}$$ (05)

$$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$$

Since 25 cm^3 of CH_3COOH requires 25 cm^3 NaOH,

Concentration of NaOH = 0.1 $mol\ dm^{-3}$ (05)

(ii) Point A : Addition of 12.5 cm^3 NaOH represents half neutralized point.

∴ The solution contains CH_3COOH / CH_3COONa in equal amounts.

Buffer soln.

$$pH = pK_a + \log\frac{[Salt]}{[Acid]}$$ where [Salt] = [Acid] (05)

$$pH = pK_a = -\log_{10}K_a = -\log_{10}(1\times10^{-5})$$

$$= 5 \text{ ---} (05)$$

Point B : This represents pH at equivalence pt which is due to hydrolysis of salt formed.

$$CH_3COO^-_{(aq)} + H_2O_{(l)} \rightleftharpoons CH_3COOH_{(aq)} + OH^-_{(aq)}$$

$$K_{b(CH_3COO^-)} = \frac{K_w}{K_a} = \frac{1\times10^{-14}\ mol^2\ dm^{-6}}{1\times10^{-5}\ mol\ dm^{-3}}$$

$$= 1\times10^{-9}\ mol\ dm^{-3} \text{ ---} (05)$$

$$[OH^-_{(aq)}] = \sqrt{ck_b}$$

Initial $[CH_3COO^-_{(aq)}] = \frac{0.1}{1000}\times25\times\frac{1000}{50}\ mol\ dm^{-3}$

$$= 0.05\ mol\ dm^{-3} \text{ ---} (05)$$

$$[OH^-_{(aq)}] = \sqrt{0.05\times1\times10^{-9}}\ mol\ dm^{-3}$$

$$= 5\sqrt{2}\times10^{-6}\ mol\ dm^{-3} \text{ ---} (05)$$

$$pOH = 6 - \log_{10}7.07$$

$$pH = 14 - (6 - \log_{10}7.07) = 8 + \log_{10}7.07$$

$$= 8.848 \text{ ---} (05)$$

Part II B Essay

25 (a) Initial amount of CH_3COOH = $2 mol dm^{-3} \times 0.05 dm^3$
= 0.1 mol (10)

After partioning

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

For the titration of $25 cm^3$ aqueous layer
no. of moles of NaOH needed = $1 mol dm^{-3} \times 18.75 \times 10^{-3} dm^3$
= 1.875×10^{-2} mol

№ of moles of CH_3COOH = 1.875×10^{-2} mol (05) (in $25 cm^3$)

∴ In $100 cm^3$ aqueous layer = 0.075 mol. (05)

№ of moles of CH_3COOH in
$50 cm^3$ butanol = 0.1 − 0.075
= 0.025 mol. (05)

$$K_D = \frac{[CH_3COOH]_{butanol}}{[CH_3COOH]_{H_2O}} \quad (05)$$

$$= \frac{0.025/50}{0.075/100} = \frac{2}{3} \quad (10)$$

(b) (i) $HA_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + A^-_{(aq)}$ (04)

50

$$K_a = \frac{[H_3O^+_{(aq)}][A^-_{(aq)}]}{[HA_{(aq)}][H_2O_{(l)}]} \quad (04)$$

Since $[H_2O_{(l)}]$ = const (02), $K_c \times [H_2O_{(l)}] = \frac{[H_3O^+_{(aq)}][A^-]}{[HA_{(aq)}]}$

$$K_a = \frac{[H_3O^+_{(aq)}][A^-_{(aq)}]}{[HA_{(aq)}]} \quad (05)$$

(ii) $HA_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + A^-_{(aq)}$

Initial: $c\ mol dm^{-3}$ 0 0

at eq^m: $(c-x)$ x x $mol dm^{-3}$

$$K_a = \frac{[H_3O^+_{(aq)}][A^-_{(aq)}]}{[HA_{(aq)}]} = \frac{x^2}{c-x}$$

Compared to c, x is negligible

$$c - x \simeq c$$

$$\therefore K_a = \frac{x^2}{c} \quad \text{---} \quad (05)$$

$$x = [H_3O^+_{(aq)}] = \sqrt{cK_a} \quad (05)$$

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

$$pH = -\log_{10}(cK_a)^{\frac{1}{2}} \quad (05) \quad \text{or} \quad pH = -\frac{1}{2}\log_{10}c - \frac{1}{2}\log_{10}K_a$$

(iii) $HA + NaOH \longrightarrow NaA + H_2O$

$$NaA_{(aq)} \longrightarrow Na^+_{(aq)} + A^-_{(aq)}$$

$$Na^+_{(aq)} + H_2O_{(l)} \longrightarrow X$$

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

$$K_h = \frac{[HA_{(aq)}][OH^-_{(aq)}]}{[A^-_{(aq)}]} = \frac{[HA_{(aq)}][OH^-_{(aq)}][H^+_{(aq)}]}{[A^-_{(aq)}][H^+_{(aq)}]}$$

$$= \frac{K_w}{K_a} \quad (05)$$

(iv) $CH_3COO^-_{(aq)} + H_2O_{(l)} \rightleftharpoons CH_3COOH_{(aq)} + OH^-_{(aq)}$

Initial: $0.01\ mol\,dm^{-3}$

at eq^m: $0.01 - x \qquad x \qquad x$

$$K_{h(CH_3COO^-)} = \frac{x^2}{0.01 - x} \simeq \frac{x^2}{0.01}$$

$$x = (0.01\,K_h)^{\frac{1}{2}}$$

$$K_h = \frac{K_w}{K_a} = \frac{1 \times 10^{-14}\ mol^2\,dm^{-3}}{1.8 \times 10^{-5}\ mol\,dm^{-3}} = 5.56 \times 10^{-10}\ mol\,dm^{-3} \quad (05)$$

$$\therefore [OH^-] = x = (0.01 \times 5.56 \times 10^{-10})^{\frac{1}{2}}$$

$$= (5.56 \times 10^{-12})^{\frac{1}{2}}\ mol\,dm^{-3}$$

$$= \sqrt{5.56} \times 10^{-6}\ mol\,dm^{-3} \quad (05)$$

$$pOH = 6 - \frac{1}{2}\log_{10}5.56$$

$$pH = 8 + \frac{1}{2}\log_{10}5.56 = \quad (05)$$

c) (I) For 'pH = 9

$$[OH^-_{(aq)}] = \frac{K_w}{[H^+_{(aq)}]} \quad \therefore [H^+_{(aq)}] = 1\times10^{-9}\ mol\,dm^{-3} \quad (05)$$

$$= \frac{1\times10^{-14}\ mol^2dm^{-6}}{1\times10^{-9}\ mol\,dm^{-3}} = 1\times10^{-5}\ M \quad (05)$$

Ionic product of $Mg(OH)_2 = [Mg^{2+}_{(aq)}][OH^-_{(aq)}]^2$

$= 1\times10^{-4}\ mol\,dm^{-3} \times (1\times10^{-5}\ mol\,dm^{-3})^2$

$= 1\times10^{-14}\ mol^3dm^{-9}$ (05)

Since I.P $< K_{sp}$, $Mg(OH)_2$ will not be precipitated at pH = 9. (05)

The minimum concentration of OH^- ions at which Mg^{2+} ions start precipitating is

$$[OH^-] = \left\{\frac{K_{sp(Mg(OH)_2)}}{[Mg^{2+}_{(aq)}]}\right\}^{1/2} = \left\{\frac{2.5\times10^{-12}\ mol^3dm^{-9}}{10^{-4}\ mol\,dm^{-3}}\right\}^{1/2}$$

$= 2.915\times10^{-4}\ mol\,dm^{-3}$ (05)

The corresponding $[H^+] = \frac{K_w}{[OH^-]}$

$= \frac{1\times10^{-14}\ mol^2dm^{-6}}{2.915\times10^{-4}\ mol\,dm^{-3}}$ ... (05)

$[H^+_{(aq)}] = 3.43\times10^{-11}\ mol\,dm^{-3}$ (05)

(II) 25

$NH_4HS_{(s)} \rightleftharpoons NH_{3(g)} + H_2S_{(g)}$

Initially: 3.06 g (= 0.06 mol) — —

At equilm: 0.7 × 0.06 mol, 0.3 × 0.06 = 0.018 mol, 0.3 × 0.06 mol = 0.018 mol ... 2×03 = 06

(i) $K_c = [NH_{3(g)}][H_2S_{(g)}]$ ... (04)

$= \left(\frac{0.018\ mol}{2\ dm^3}\right)\left(\frac{0.018\ mol}{2\ dm^3}\right)$ ... (02)

$K_c = 8.1\times10^{-5}\ mol^2dm^{-6}$ ... (03)

Using $K_p = K_c(RT)^{\Delta n}$ where $\Delta n = 2$,

$K_p = 8.1\times10^{-5}\ mol^2dm^{-6} \times (8.314\ Nmmol^{-1}k^{-1}\times300k)^2$ ... (05)

— 04 —

(ii) Equilibrium is not affected by the introduction of more of solid NH_4HS as the equilibrium constant is independant of the quantity of solid. --- (05)

Q. 6 (a) (I)

(a) 75

(i) Rate order : Rate of a reaction is proportional to the concentration of a reactant raised to some certain power which is called the order w.r.t that reactant. Overall order is the sum of individual orders of each reactants.

3×05 = (15)

Average rate : is the average of the individual rate measured over a particular time interval.

R.D.S : is the slowest step (or which has the highest E_a)

(II) (i) A ⇒ Reactants, B ⇒ 1st activated complex, C ⇒ Intermediate, D ⇒ 2nd activated complex, E ⇒ Products 5×03 = (15)

(ii) (I) Enthalpy of reaction = −(c−a)

(II) 1st E_a = e−c, 2nd E_a = d−b 3×05 = (15)

(iii) B ⇒ $CH_3-\overset{CH_3}{\underset{CH_3}{C^{\delta+}}}\cdots Br^{\delta-}$, C ⇒ $(CH_3)_3C^+$, D ⇒ $CH_3-\overset{CH_3}{\underset{CH_3}{C^{\delta+}}}\cdots Cl^{\delta-}$

3×05 = (15)

(b)(i) Initial no. of moles of A = $\frac{2 \times 50}{1000}$ mol = 0.1 mol (05)

75

Reacted amt. of A = $0.1 \times \frac{20}{100}$ mol = 2×10^{-2} mol (05)

Rate of consumption of A = $2 \times 10^{-2}\ \text{mol} \times \frac{1}{0.2\ \text{dm}^3} \times \frac{1}{4\ \text{s}}$ (05)

$= 25 \times 10^{-3}\ \text{mol dm}^{-3}\ \text{s}^{-1}$ (05)

(ii) Rate of consumption of B = $2 \times 25 \times 10^{-3}\ \text{mol dm}^{-3}\ \text{s}^{-1}$ (05)

$= 50 \times 10^{-3}\ \text{mol dm}^{-3}\ \text{s}^{-1}$ (05)

(iii) Rate = $k[A]^a[B]^b[C]^c$ (05) where a, b and c are rate orders w.r.t A, B and C.

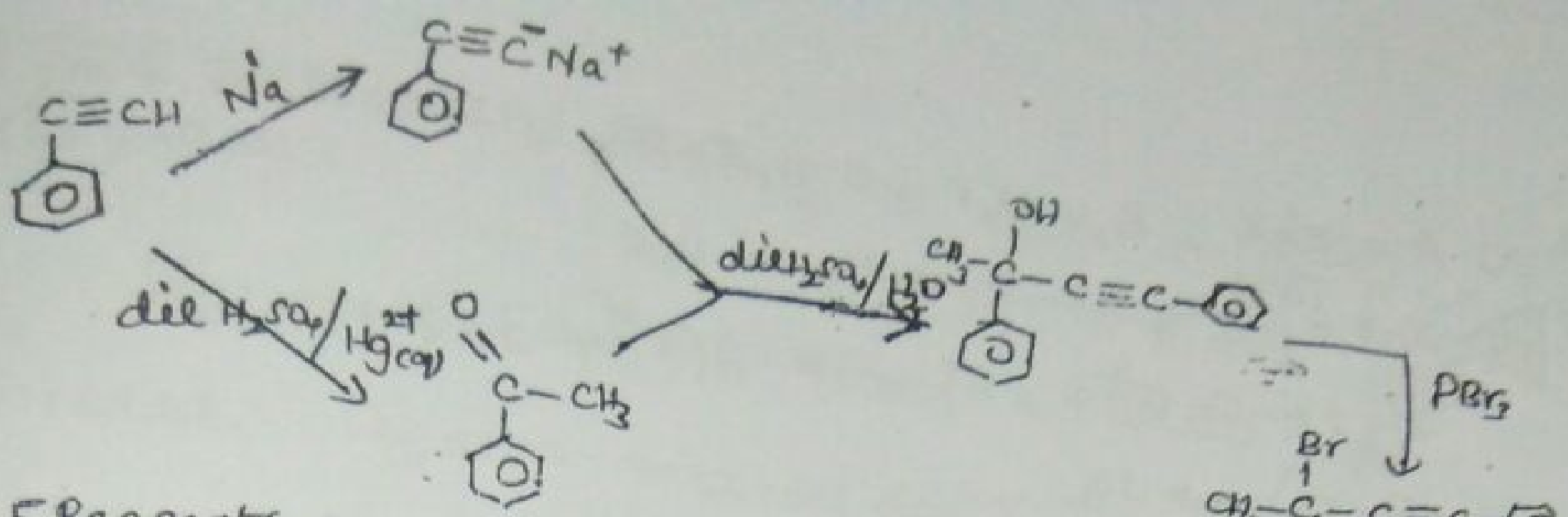
(iv) a = 1, b = 1, c = 0 3×05 = (15)

(v) R = k[A][B] --- (10)

(vi) A + B → AB / ≡ slowest step (05)

molecularity of RDS = 2 ---- (05)

(a)



5 Reagents
4 Products } 9 x 05 = (45)

Product

(b) R_1 = HBr

$R_2 = NaOH_{(aq)}$

$R_3 = H^+/KMnO_4$
or $H^+/K_2Cr_2O_7$
or PCC.

$R_4 = HBr/R_2O_2$

$R_5 = Mg/Dry\ ether$

5 x 05 = (25)

$X_1 = CH_3-CH(Br)-CH_3$

$X_2 = CH_3-CH(OH)-CH_3$

$X_3 = CH_3CH_2CH_2Br$

$X_4 = CH_3CH_2CH_2MgBr$

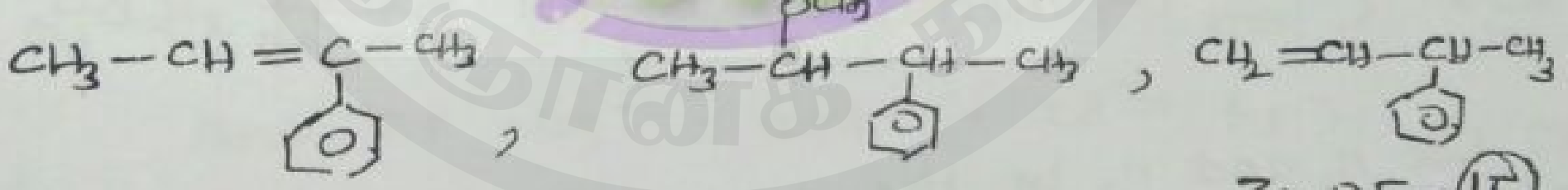
$X_5 = CH_3CH_2CH_2OH$

$R_6 = H^+/KMnO_4\ CH_3CH_2COOH$

$X_7 = CH_3CH_2CH_2-C(CH_3)_2-OH$

7x 05 = (35)

(c) (i)



3 x 05 = (15)

(ii) (I) The lone pair electrons on O atom are delocalized with the π electron cloud of the benzene ring in phenol. (Resonance structures)

(15) As a result, a double bond nature is developed in carbon– oxygen bond and it becomes shorter and stronger. ∴ Difficult to break and hence does not undergo nucleophilic sub.

(II) $CH_3-\overset{O}{\overset{\|}{C}}-NH_2 < C_6H_5NH_2 < NH_3 < CH_3CH_2NH_2 < CH_3CH_2-\underset{CH_3}{\underset{|}{N}}H$

(15) Explanation for the above on the basis of donating ability of lone pair of electrons on N atom.

(a) $A = ZnS$, $B = H_2S$, $C = ZnSO_4$, $D = S$, $E = SO_2$
5x 04 = (20)

(50)

$ZnS + H_2SO_4$ (dil) $\longrightarrow ZnSO_4 + H_2S$

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

$S + O_2 \longrightarrow SO_2$

$SO_2 + 2H_2S \longrightarrow 3S + 2H_2O$

$Zn^{2+}_{(aq)} + 2OH^-_{(aq)} \longrightarrow Zn(OH)_{2(s)}\downarrow$ ppt.

$Zn(OH)_{2(s)} + 2OH^-_{(aq)} \longrightarrow [Zn(OH)_4]^{2-}_{(aq)}$ 6x05 = (30)

(b) (i) Al^{3+}, Ag^+, Zn^{2+} - - - - 3x 05 = (15)

(50)

(ii) (1) – $Al(OH)_3$
(2) – $AgCl$
(3) – $Zn(OH)_2$
} 3x 05 = (15)

(iii) A white precipitate forms when HCl is added slowly and the precipitate redissolves on addition of excess $HCl_{(aq)}$ (10)

$[Al(OH)_4]^- + H^+ \longrightarrow Al(OH)_3\downarrow + H_2O$

$Al(OH)_{3(s)} + 3HCl_{(aq)} \longrightarrow AlCl_{3(aq)} + 3H_2O_{(l)}$
} 2x05 = (10)

(c) Let n_1 and n_2 be the amts. of $KClO_3$ and KCl present in 25 cm³ of the sol^n obtained by dissolving 1g of sample in 250 cm³ H_2O.

(50)

$$ClO_3^- + 3SO_2 + 3H_2O \longrightarrow Cl^- + 3H_2SO_4$$

Amt. of Cl^- obtained by the reduction of ClO_3^- is also equal to n_1.

$$n_1 + n_2 = \frac{0.1435\,g}{M_{AgCl}} = \frac{0.1435\,g}{143.5\,g\,mol^{-1}} = 10^{-3}\,mol$$ (05)

In the 2nd expt:

$$Fe^{2+}_{(unreacted)} : KMnO_4 = 5 : 1$$

No of moles of $KMnO_4$ = $0.02\ mol\ dm^{-3} \times 7.5 \times 10^{-3}\ dm^3$

$= 6 \times 10^{-4}$ mol (05)

$\therefore n_{Fe^{2+}} = 5 \times (6 \times 10^{-4})\ mol = 3 \times 10^{-3}$ mol (05)

Initial $n_{Fe^{2+}} = 0.2\ mol\ dm^{-3} \times 30 \times 10^{-3}\ dm^3$ (05)

$= 6 \times 10^{-3}$ mol

∴ Amt. of Fe^{2+} ions used in reducing ClO_3^- ion

$= (6 \times 10^{-3} - 3 \times 10^{-3})$ mol

$= 3 \times 10^{-3}$ mol (05)

From the eqn $ClO_3^- + 6Fe^{2+} + 6H^+ \longrightarrow Cl^- + 6Fe^{3+} + 3H_2O$

amt. of ClO_3^- (in 25cm³) $= \frac{1}{6} \times 3 \times 10^{-3}$ mol

$= 5 \times 10^{-4}$ mol (05)

Amt. of Cl^- (in 25cm³) $= (10^{-3} - 5 \times 10^{-4})$ mol

$= 5 \times 10^{-4}$ mol (05)

In 250 cm³ of the soln,

amt. of ClO_3^- = 5×10^{-3} mol

amt. of Cl^- = 5×10^{-3} mol } 2×02 = 04

Hence, amt. of ClO_3^- : amt. of Cl^- = 1 : 1

Mass of $KClO_3$ = $5 \times 10^{-3}\ mol \times 122\ g\ mol^{-1}$

$= 0.61$ g --- (03)

Mass of KCl = $5 \times 10^{-3}\ mol \times 74.5\ g\ mol^{-1}$

$= 0.3725$ g --- (02)

Mass of moisture (in 1g sample) = $1g - (0.61 + 0.3725)g$

$= 0.0175$ g

Mass percent of moisture = $\frac{0.0175\ g}{1\ g} \times 100$ %

$= 1.75$ % ... (05)

(iii) $Hg_{(l)} / Hg_2Cl_{2(s)} // Cl^-_{(aq.,\ 1mol\,dm^{-3})} / Cl_{2(g,1atm)} / Pt_{(s)}$

(iv) $E^{\ominus}_{cell} = E^{\ominus}_{cathode} - E^{\ominus}_{Anode}$

$= 1.36V - 0.24V = 1.2V$

(v) $2Hg_{(l)} + Cl_{2(g)} \longrightarrow Hg_2Cl_{2(s)}$

5) (ii) M = Co / Cobalt (10)

(iii) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^7$ (05)

(iii) +2, +3 $2 \times 02 =$ (04)

(iv) Formation of blue precipitate and it dissolves on addition of excess $NH_{3(aq)}$ to give yellow brown solution which turns brown (06)

(v) blue precipitate $Co(OH)_2$

yellow brown soln $[Co(NH_3)_6]^{2+}$

brown $[Co(NH_3)_6]^{2+}$ $2 \times 05 =$ (10)

(vi) (I) A ⇒ Diammine tetraaqua cobalt (II) chloride

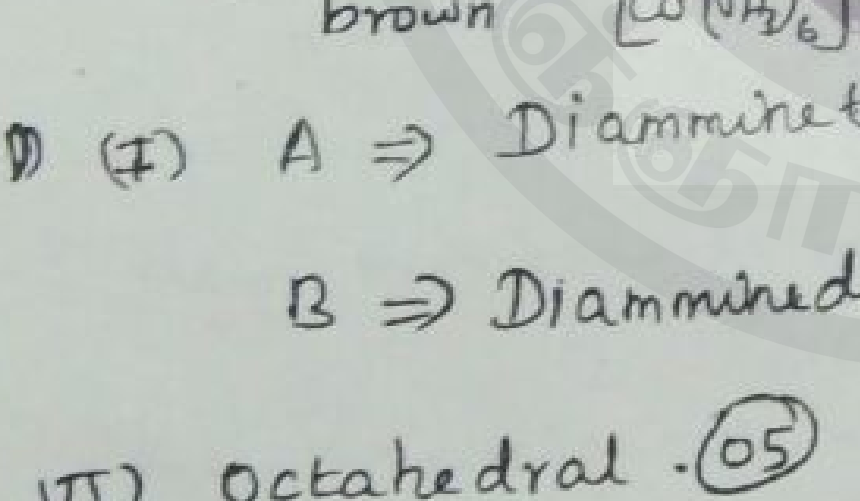
B ⇒ Diammine diaqua dichloridocobalt(II) chloride

$2 \times 05 =$ (10)

(II) Octahedral (05)

(iii) • Take equal volumes of A and B (∵ identical test tubes)
• Add equal volumes of given $AgNO_{3(aq)}$ in excess to both
• Ppt. is higher in A $2 \times 05 =$ (10)

(iv)



Cationic charge = +2 (05)

(10) (a) (I) (i) The mass of a chemical substance deposited at an electrode during electrolysis is directly proportional to the quantity of electricity (expressed in coulombs) passed through the cell.

(II) The masses of different substances produced by the same quantity of electricity are proportional to the equivalent mass of the substances. $2 \times 10 = (20)$

(ii) Volume of metal deposited $= 80\ cm^2 \times 5 \times 10^{-4}\ cm$

$= 0.04\ cm^3$ (05)

Mass of metal deposited $= \rho V = 10.8\ g\ cm^{-3} \times 0.04\ cm^3$

$= 0.432\ g$ (05)

Amount of metal deposited $= \frac{0.432\ g}{108\ g\ mol^{-1}} = 0.004\ mol$ (05)

Quantity of electricity passed $= 0.004\ mol \times 96,500\ C\ mol^{-1}$

$= 386\ C$ (05)

Time for which 4A current is passed $= \frac{386\ C}{4\ A} = 96.5\ s$. (05)

(9) (a) (i) Sea water is pumped into three tanks and evaporated successively (13)

1st tank : $CaCO_3$ precipitates. (03)

Remaining solution transferred to 2nd tank (02)

2nd tank : $CaSO_4$ precipitates (03)

Remaining solution transferred to 3rd tank (02)

3rd tank : NaCl precipitates (03)

Remaining solution (bittern) is removed (02)

(ii) Water impervious clay sand, sun light, dry air, less rain fall

$3 \times 4 = 12$

Final marks

Part I 50/.

Part II - Structure $4 \times 100 = 400$

Essay $4 \times 150 = 600$

Total 1000

(i) (a) (ii) (i) NaCl (05) (ii) $CaCl_2$ (05) (iii) ~ 600°C (05)

(iv) anode – graphite (v) anode: $2Cl^-_{(l)} \longrightarrow Cl_{2(g)} + 2e$

cathode – steel cathode: $Na^+_{(l)} + e \longrightarrow Na_{(l)}$

2×05=10 2×05=10

(vi) To prevent the reaction of Na with Cl_2 (05)

(vii) To prevent Na from reacting with O_2 and moisture (05)

(viii) Uses of Na: Use of Cl_2

- Sodium vapour lamps
- In organic synthesis
- As a cooling fuel in nuclear reactors

- as a bleach
- disinfectant
- Preparation of pvc.

} any one (05)

(b) (i) $2Cr^{3+}_{(aq)} + 3H_2O_{2(aq)} + 10OH^-_{(aq)} \longrightarrow 2CrO_4^{2-}{}_{(aq)} + 8H_2O_{(l)}$

(ii) $4LiNO_{3(s)} \xrightarrow{\Delta} 2Li_2O_{(s)} + 4NO_{2(g)} + O_{2(g)}$

(iii) $Mg_{(s)} + 2NH_4Cl_{(aq)} \longrightarrow MgCl_2 + 2NH_3 + H_2$

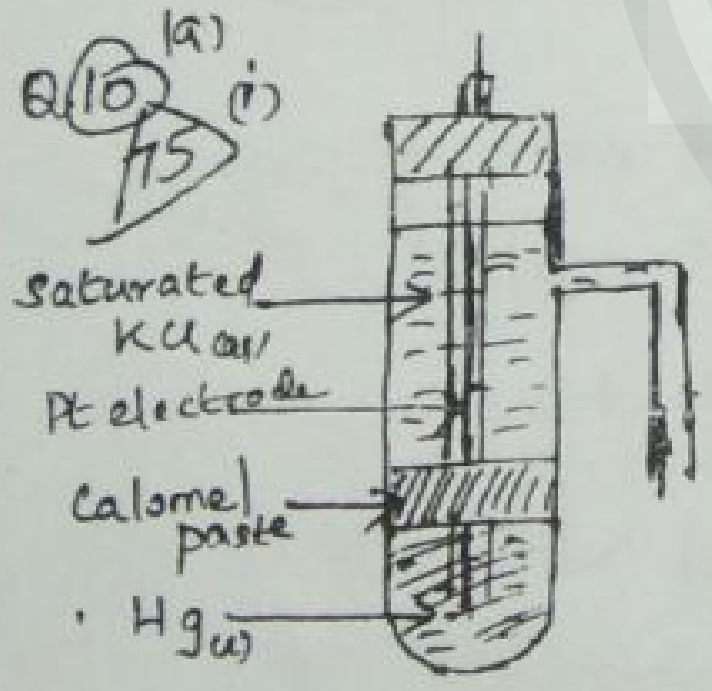
(iv) $3Mg + SO_2 \longrightarrow 2MgO + MgS$
(excess)

(v) $S + (Conc)4HNO_3 \longrightarrow SO_2 + 4NO_2 + 2H_2O$

(vi) $(NH_4)_2Cr_2O_7 + 4NaOH \longrightarrow 2Na_2CrO_4 + 2NH_3 + 3H_2O$

6×10 = 60

Q10 (a) (i)



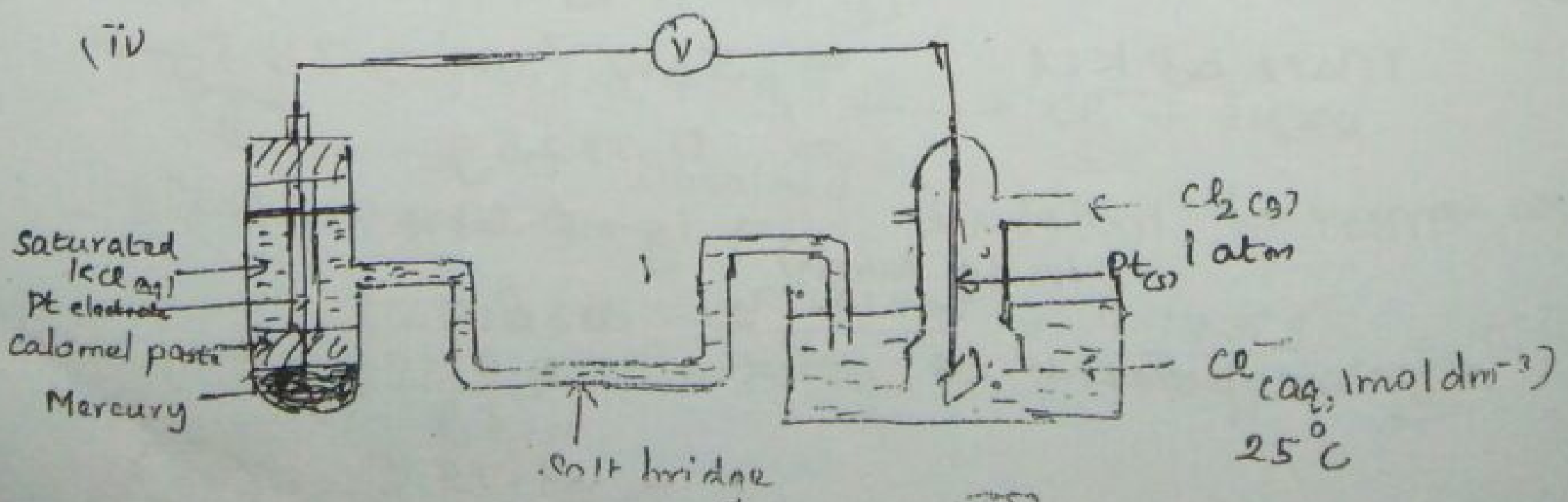
Completely labelled diagram (10)

Equilibrium electrode reⁿ

(05) $Hg_2Cl_{2(s)} + 2e \rightleftharpoons 2Hg_{(l)} + 2Cl^-_{(aq)}$

* Physical states are required.
* Equilibrium sign (⇌) important

(ii)



(15)

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