FWC

தேசிய வெளிக்கள நிலையம் தொண்டைமானாறு
ஐந்தாம் தவணைப் பரீட்சை - 2024
National Field Work Centre, Thondaimanaru
5th Term Examination - 2024

இரசாயனவியல்
Chemistry

Two Hours
Gr. 13 (2024)

02 | E | I

Part - I

01) Identify the scientist who are associated with the IR, visible, UV parts if hydrogen emission spectrum respectively.

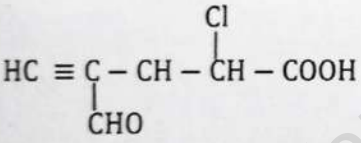
(1) Lyman, Balmer, Paschen
(2) Balmer, Lyman, Paschen
(3) Balmer, Paschen, Lyman
(4) Paschen, Balmer, Lyman
(5) Lyman, Paschen, Balmer

02) Wrong statement

(1) Ionic radius $K^+ < O^{2-} < Cl^- < S^{2-}$
(2) Atomic radius $S < Li < Al < Na$
(3) 2nd ionization energy $Mg < Si < Al < Na$
(4) Electro magnetic energy - Microwave < UV < X – ray < γ - ray
(5) electronegativity of N atom $NH_3 < NH_4^+ < NO_3^- < NO_2^+$

03) Ksp of $Zr_3(PO_4)_4$ is $6.912 \times 10^{-46} mol^7 dm^{-21}$. What is the concentration of Zr^{4+} in $moldm^{-3}$.

(1) 1×10^{-7} (2) 1×10^{-7} (3) 1×10^{-49} (4) 3×10^{-14} (5) 3×10^{-7}

04)  What is the correct IUPAC name of this component.

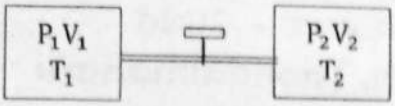
(1) 2 – chloro – 3 – formyl – 4 – pentynoic acid
(2) 2 – chloro – 3 – formyl pent – 4 – ynoicacid
(3) 3 – formyl – 2 – chloro – 4 – pentynoic acid
(4) 3 – formyl – 2 – chloropent – 4 – ynoicacid
(5) 2 – chloro – 3 – formyl – 4 – pentyneoic acid

05) Which pair of ionic solutions below forms a clear solution when it's mixed and it also forms a white precipitate, when it is heated.

(1) $Pb(NO_3)_{2(aq)} + KCl_{(aq)} \rightarrow$
(2) $Na_2CO_{3(aq)} + MgCl_{2(aq)} \rightarrow$
(3) $NaHCO_{3(aq)} + Ba(NO_3)_{2(aq)} \rightarrow$
(4) $Na_2SO_{4(aq)} + BaCl_{2(aq)} \rightarrow$
(5) $K_2CO_{3(aq)} + SrCl_{2(aq)} \rightarrow$

06) Find the electron pair geometry of central atom of $BrOCl_2F$, $BrFO_2$, BrF_3Cl^- respectively.

(1) See saw, Trigonal pyramidal, Square planer
(2) Tetrahedral, Trigonal planer, Octahedral
(3) Trigonal bipyramidal, Tetrahedral, Octahedral
(4) Octahedral, Tetrahedral, Trigonal bipyramidal
(5) Tetrahedral, Trigonal bipyramidal, Octahedral

07) 

Initially two different ideal gases which are unreactive with each other are stored in two vessel, like shown in the picture. Then the tap is opened and both of them are allowed to mix with each other.

The final pressure is P_3 and the final temperature is T_3. What is the correct formula for T_3.

(1) $\frac{T_2P_1V_1 + P_2V_2T_1}{(P_3V_1 + P_3V_2)T_1T_2}$ (2) $\frac{(P_3V_1 + P_3V_2)T_1T_2}{T_2P_1V_1 + P_2V_2T_1}$ (3) $\frac{P_3V_2 - P_3V_1T_1T_2}{T_2(P_1V_1 + P_2V_2)T_1}$

(4) $\frac{T_1P_3V_1 + P_3V_2T_2}{(P_1V_1 - P_2V_2)T_1T_2}$ (5) $\frac{(P_3V_1 + P_2V_2)T_2}{(P_3V_2 + P_1V_1)T_1}$

08) Find the ΔH_D^0 of O – H in $H_2O_{(g)}$ with use the data below.

O_2 (bond dissociation) $\Delta H_D^0 = +500\ kJmol^{-1}$,

H (atomization) $\Delta H_{atom}^0 = +216\ kJmol^{-1}$, $H_2O_{(l)}$ (Formation) $\Delta H_f^0 = -284\ kJmol^{-1}$,

$H_2O_{(l)}$ (vapourition) $\Delta H_{vap}^0 = +44\ kJmol^{-1}$

(1) + 478 (2) + 461 (3) + 922 (4) + 956 (5) + 483

09) 0.535 g of solid NH_4Cl is dissolved in the 0.4 M HNO_3 solution of 100 cm^3. Calculate the pH value of the solution. [K_a of $NH_4^+ = 1 \times 10^{-9} moldm^{-3}$]

(1) 9.4 (2) 5.6 (3) 5.4 (4) 9.6 (5) 10.6

10) $CH_3 - \overset{\overset{O}{\|}}{C} - NH_2 \xrightarrow[\Delta]{NaOH} A \xrightarrow{dil\ H_2SO_4} B \xrightarrow{PCl_3} C$

Find the correct organic products for A, B, C from the reaction above

(1) $CH_3CH_2NH_2$, $CH_3CH_2NH_3^+$, CH_3CH_2Cl

(2) CH_3COOH, CH_3CHO, CH_3COCl

(3) $CH_3COO^-Na^+$, CH_3COOH, CH_3CH_2Cl

(4) $CH_3COO^-Na^+$, CH_3CH_2OH, CH_3CH_2Cl

(5) $CH_3COO^-Na^+$, CH_3COOH, CH_3COCl

11) 350 g Fe_2O_3 is reduced by C and it formed 224 g Fe. Calculate the minimum mass of C used in this reaction. [$Fe_2O_3 + C \rightarrow Fe + CO$] [Fe – 56, C – 12, O - 16]

(1) 36 g (2) 24 g (3) 12 g (4) 48 g (5) 60 g

12) Which complex – ions show the colours as blue, green, purple respectively.

(1) $[Ni(H_2O)_6]^{2+}$, $[Cu(NH_3)_4]^{2+}$, $[Cr(H_2O)_6]^{3+}$

(2) $[Cu(H_2O)_6]^{3+}$, $[Cr(H_2O)_6]^{3+}$, $[Co(H_2O)_6]^{2+}$

(3) $[Cu(H_2O)_6]^{2+}$, $[Ni(H_2O)_6]^{2+}$, $[Cr(H_2O)_6]^{3+}$

(4) $[Cu(NH_3)_6]^{2+}$, $[Ni(OH)_2(H_2O)_4]$, $[CrCl_2(H_2O)_4]$

(5) $[Co(NH_3)_6]^{2+}$, $[NiCl_4]^{2-}$, $[Zn(NH_3)_6]^{2+}$

13) A → B Concentration of the reactant A changed from 1.6 $moldm^{-3}$ to 0.05 $moldm^{-3}$ in the primary reaction above it took 500 seconds. Find the value of rate constant(K),

(1) $6.93 \times 10^{-2}\ s^{-1}$ (2) $6.93 \times 10^{-4}\ s^{-1}$ (3) $0.693\ s^{-1}$

(4) $6.93 \times 10^{-3}\ s^{-1}$ (5) $1.386 \times 10^{-2}\ s^{-1}$

14) Which of the following shows the minimum change in the pH when 1 cm^3 of 0.1 M HCl is added.

(1) H_2O
(2) 0.1 M HCOOH / 0.1 M HCOONa
(3) 0.1 M CH_3COOH / 0.1 M CH_3COONa
(4) 0.1 M C_2H_5COOH / 0.1 M C_2H_5COONa
(5) 0.1 M CH_3COOH

15) Correct statement

(1) $AlCl_{3(aq)}$ can form Al_2CO_3 precipitate with Na_2CO_3.
(2) When $KMnO_4$ is added to dil H_2SO_4 with NaCl solution it forms $HCl_{(g)}$
(3) K_2CrO_4 , $Cr(OH)_3$ will be formed, when you add NaOH to $K_2Cr_2O_7$
(4) When $FeCl_3$ is added into $K_3[Fe(CN)_6]$. It turns into blue.
(5) If con. H_2SO_4 is heated with KI, It'll form a purple smoke.

16) Ag / AgCl electrode acts as cathode in a cell. 2.5 A current is got for 386 seconds. Find the differentiation of mass in Ag / AgCl electroride

(1) Increased by 1.435 g
(2) Decreased by 1.435 g
(3) Decreased by 0.355 g
(4) Increased by 0.355 g
(5) Decreased by 1.08 g

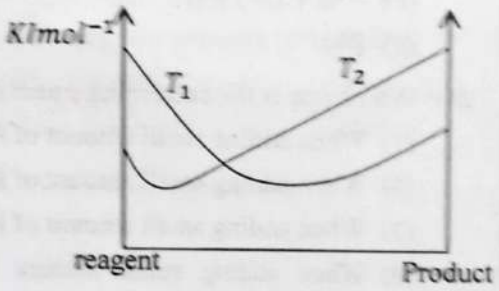
17) Select the wrong statement.

(1) Mg has the low melting point in group 2.
(2) AlF_3 can be formed to Al_2F_6 to stable.
(3) Both NO, NO_2 doesn't complete the octet where as N_2O_3 completes the octet structure.
(4) Al^{3+} has the higher polarization power than Na^+.
(5) Melting point of graphite is a little bit higher than the melting point of diamond.

18) In T K temperature ionic product of water $k_w = 1 \times 10^{-13} mol^2 dm^{-6}$. Calculate the pH value of $1 \times 10^{-2} moldm^{-3}$ $NaOH_{(aq)}$ was diluted by 100 times in T K

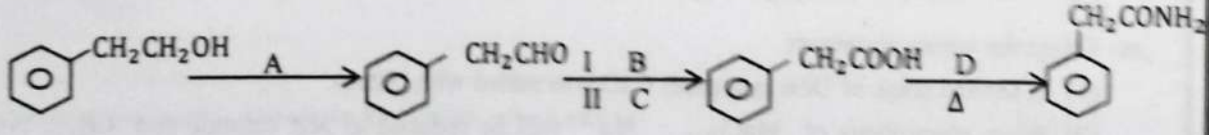
(1) 9 (2) 10 (3) 4 (4) 2 (5) 12

19) The variation of standard Gibbs Energy of $R \rightleftharpoons P$ with the extent of reaction at two different temperature in constant pressure is shown in the figure which correct statement of it



(1) If $T_1 > T_2$ it is endothermic forward reaction.
(2) Equilibrium constant in T_2 is greater than T_1
(3) If $T_1 > T_2$ it is exothermic forward reaction.
(4) In T_1 temperature ΔG nearly equal to zero but in T_2 $\Delta G > 0$.
(5) In T_2 the reaction which goes to a completion in which near the end point

20)



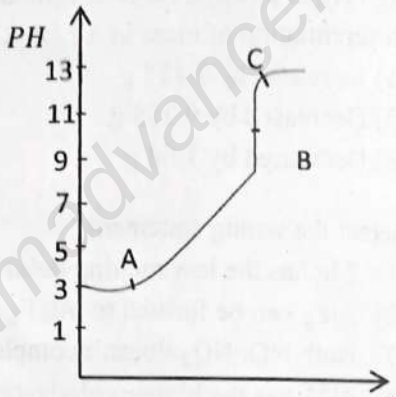
Identify the A, B, C, D.

(1) PCC, $KMnO_4$, H_2SO_4, NH_3
(2) $LiAlH_4$, H_2SO_4, PCC, NH_3
(3) PCC, $[Ag(NH_3)_2]^+$, dil HCl, NH_3
(4) $K_2Cr_2O_7$, $NaBH_4$, CH_3OH, NH_3
(5) PCC, $LiAlH_4$, H_2SO_4, NH_3

21) An Inorganic coloured compound A was decomposed reaction under higher temperature it gives green colour residue B and gas C. When C react with metal M gives D, D react with water give gas E. Identify A, B, C, D, E, M

	A	B	C	D	E	M
(1)	$(NH_4)_2CrO_4$	Cr_2O_3	N_2	Na_3N	NH_3	Na
(2)	$(NH_4)_2Cr_2O_7$	Cr_2O_3	N_2	Mg_3N_2	NH_3	Mg
(3)	$(NH_4)_2Cr_2O_7$	Cr_2O_3	N_2	K_3N	NH_3	K
(4)	$(NH_4)_2Cr_2O_7$	Cr_2O_3	N_2O	Ca_3N_2	NH_3	Ca
(5)	$(NH_4)_2Cr_2O_7$	CrO_3	N_2	Mg_3N_2	NH_3	Mg

22) The titration curve given was obtained for the titration of 1 M 25 cm^3 CH_3COOH with 1 M NaOH of the statement given below identify the incorrect statement.



(1) In area A show buffer nature.

(2) Point B is end point of the titration and it contains basic salt.

(3) In area C does not show buffer.

(4) If it was titrated with more Ka acid than CH_3COOH initial pH point is less than 3.

(5) If $NH_4OH_{(aq)}$ used instead of NaOH same pattern of graph was obtained.

23) A and B are immiscible liquid I_2 was distributed among them partition co – efficient of I_2 with A and B 39. [I_2 more soluble in B than A] 8 $moldm^{-3}$ I_2 dissolved A solution 100 cm^3 sample was 2 times mixed separated with 100 cm^3 B calculate the final concentration of I_2 in A solution

(1) 0.005 (2) 0.05 (3) 0.5 (4) 0.2 (5) 0.02

24) Concentration of Fe^{3+} in $FeCl_{3(aq)}$ is 1300 ppm. Calculate Cl^- in 250 cm^3 aqous solution in mg [Fe – 56, Cl – 35.5]

(1) 840 (2) 710 (3) 532.5 (4) 355 (5) 213

25) Which one is the correct statement about saturated aqueous solution of a sparingly salt AgCl.

(1) When adding small amount of $AgNO_3$ AgCl will be dissolved.

(2) When adding small amount of KCl AgCl will be dissolved.

(3) When adding small amount of KNO_3 AgCl will be precipitated.

(4) When adding small amount K_2CrO_4 small amount of AgCl dissolved and reddish brown precipitate formed.

(5) When adding of $NH_{3(aq)}$ to a solution amount of precipitate will not be changed.

26) Select the wrong statement

(1) In second stage of Daw processes CaO was added with bittern.

(2) When electrolysis of $MgCl_{2(l)}$, Mg^{2+} will be reduced as Mg cathode and $Cl_{2(g)}$ evolved in anode.

(3) When NaOH produced by membrane cell process Ti anode any Ni cathode was used.

(4) In cathode room H_2O was insert and NaOH was exit in membrane cell process.

(5) In production of NaOH membrane prevent only $Cl_{2(g)}$ react with $H_{2(g)}$

27) Consider about two electroide.

$Pt_{(s)} / Hg_{(s)}, Hg_2Cl_{2(s)}/Cl^-_{(aq)}$ $\quad E^0 = 0.27\ V$

$Pt_{(s)} / Cl_{2(g)}/Cl^-_{(aq)}$ $\quad E^0 = 1.36\ V$

Which one is correct cell reaction and E^0 cell value of the cell

(1) $Hg_2Cl_{2(s)} \rightarrow 2Hg_{(l)} + Cl_{2(g)}$ $\quad E^0 = -1.09\ V$

(2) $2Hg_{(l)} + Cl_{2(g)} \rightarrow Hg_2Cl_{2(s)}$ $\quad E^0 = 1.09\ V$

(3) $2Hg_{(l)} + 2Cl^-_{(aq)} \rightarrow Hg_2Cl_{2(s)}$ $\quad E^0 = 1.09\ V$

(4) $Hg_2Cl_{2(s)} \rightarrow Hg^{2+}_{2(aq)} + 2Cl^-_{(aq)}$ $\quad E^0 = 1.63\ V$

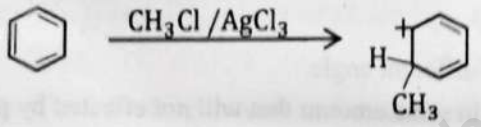
(5) $Hg^{2+}_{2(aq)} + 2Cl^-_{(aq)} \rightarrow Hg_2Cl_{2(s)}$ $\quad E^0 = 1.09\ V$

28) Which one of the intermediate product cannot be formed,

(1) $CH_3 - C \equiv CH \xrightarrow{HgSO_4, H_2SO_4} CH_3 - \overset{OH}{\overset{|}{C}} = CH_2$

(2) $CH_3 - CH_2 - CHO \xrightarrow{NaOH} {}^-CH_2CH_2CHO + H_2O$

(3) $CH_3 - \overset{O}{\overset{\|}{C}} - Cl \xrightarrow{{}^-OH} CH_3 - \overset{O^-}{\overset{|}{\underset{OH}{\underset{|}{C}}}} - Cl$

(4) 

(5) $CH_3CH = CH_2 \xrightarrow{Con\ H_2SO_4} CH_3 - \overset{+}{C}H - CH_3$

29) A and B are two volatile liquids that can form an ideal solution when A and B solution is in equilibrium with the vapour mole ratio of A : B = 1 : 5 in liquid stage mole ratio of A : B = 4 : 3 in vapour phase total pressure of the system 7×10^4 Pa the saturate vapour pressure of A, B are,

(1) 2.4×10^4 , 3.6×10^4 (2) 2×10^4 , 3×10^6

(3) 4×10^4 , 3×10^4 (4) 4.8×10^4 , 1.8×10^5

(5) 2.4×10^5 , 3.6×10^4

30) SO_2 can be reduced by,

(1) $KMnO_4 / H^+$ (2) H_2O_2 (3) $FeCl_3$

(4) H_2S (5) $CuSO_4$

❖ **The questions 31 – 40, use the following instructions.**

(1)	(2)	(3)	(4)	(5)
Only (a) and (b) are correct	Only (b) and (c) are correct	Only (c) and (d) are correct	Only (a) and (d) are correct	Any other combination.

31) Which of the following statements correctly explains when a catalyst insert a reaction rate will be increased,

a) Catalyst will be decrease the activation energy.
b) Catalyst will be increased the Kinetic energy of reaction molecule.
c) Catalyst will be changed the reaction pathway through the low activation energy.
d) It increase the concentration of products

32) Small amount of NaCl was dissolved in water sample which one is / are correct about it,

a) Boiling point will be increased
b) Melting point will be decreased
c) Evaporation rate of water will increase.
d) Triple point will not be present.

33) Butan-2-ol show 2 isomers structure which one is/are correct about it,

(a) Both 2 isomers show same chemical properties.
(b) One isomeric structure does not mirror image of other one and can't be super imposed one each other
(c) Both two compounds turns polarized light in different angle.
(d) When a solution contains both 2 compounds in same amount that will not effected by polarized light

34) Which one is/are correct about this equilibrium.

$[Ni(H_2O)_6]^{2+}_{(aq)} + NH_{3(aq)} \rightleftharpoons [Ni(NH_3)_6]^{2+}_{(aq)}$

(a) If $Q_C < K_C$ blue colour will be increased
(b) If $Q_C = K_C$ $\Delta G = 0$ becomes zero
(c) If $Q_C > K_C$ green colour will be increased
(d) If $Q_C < K_C$ forward reactions $\Delta G > 0$

35) Which one is/are correct

(a) pH will increase by 2 units when weak acid will diluted 100 times by water.
(b) pH will increase by 2 units when strong acid will diluted 100 times by water
(c) Concentration of $[H^+]$ will increase 10 times when a strong base will diluted by 10 times
(d) When a strong acid will diluted concentration of $[H^+]$ and $[OH^-]$ will be changed by same amount.

36) Which one is /are correct about A, B missible ideal solution $[P^0_A > P^0_B]$

(a) Total pressure of system will increase when mole fraction of A increase in solution.
(b) Boiling point of the solution will decrease when mole fraction of A will increase in solution.
(c) Total pressure of system will decrease when X_B will increase in solution.
(d) Pure B can obtain by partial distillery of the solution.

37) Which one is/ are incorrect statements

(a) From Sc to Co atomic radius will decrease.

(b) Electronegativity of Fe, Co, Ni, Cu in is less than Zn

(c) 3rd ionization energy of Cu > Zn

(d) Mn_2O_3 and Cr_2O_3 are amphoteric oxides.

38) Which one is / are correct about Halogens

(a) Bond dissociation energy of $F_2 < Cl_2$

(b) When F_2 react with H_2O and it oxidized H_2O and liberated O_2 gas

(c) $Cl_{2(g)}$ undergoes disproportion reaction with H_2O

(d) I_2 act as reducing agent with $Na_2S_2O_3$

39) Which one is/are correct thermochemical reaction

(a) Lattice dissociation enthalpy of NaCl $NaCl_{(s)} \rightarrow Na^+_{(g)} + Cl^-_{(g)}$

(b) Atomization enthalpy of Hg $Hg_{(s)} \rightarrow Hg_{(g)}$

(c) Bond dissociation enthalpy of $H_{2(g)}$ $\frac{1}{2}H_{2(g)} \rightarrow H_{(g)}$

(d) Hydration enthalpy of Na^+ $Na^+_{(g)} + H_2O_{(l)} \rightarrow Na^+_{(aq)}$

40) Which of the following statement is/are correct

(a) $N_{2(g)}$ and $CO_{(g)}$ have equal amount of average kinetic energy and root mean square speed in 25^0C

(b) The ratio of root mean square speed of $He_{(g)} : CH_{4(g)}$ is 2 : 1 in 25^0C

(c) Diffusion rate of $H_2O_{(g)}$ and $N_{2(g)}$ can be equalized by changing temperature

(d) O_2 and H_2 show equal density when it's present in same temperature and pressure.

❖ **Instructions for questions 41 – 50.**

Response	First statement	Second statement
1)	True	True and correctly explains the first statement.
2)	True	True, but not explain the first statement correctly
3)	True	False
4)	False	True
5)	False	False

	Statement I	Statement II
41)	$CaCO_3 \rightleftharpoons CaO_{(s)} + CO_{2(g)}$ when consider the above equilibrium $k_p = k_cRT$	In $k_p = k_c(RT)^{\Delta n}$, $\Delta n = 2 - 1$
42)	Soap is a salt of carboxylic acid composed long carbon chain	Soap is made from oils that undergoes hydrolysis reaction in basic medium.

43)	In an electrochemical cell the electrode having the higher reduction potential acts as negative electrode.	This electrode act as cathode.
44)	SO_2 can more soluble in rain water than CO_2	H_2SO_3 is strong acid than H_2CO_3
45)	Consider the following reaction in 25^0C $H_2O_{(l)} \rightarrow H_2O_{(g)}$ $\Delta G < 0,\ \Delta H > 0, \Delta S > 0$	At temperature less than 0^0C and pressure 1 atm of this reaction $\Delta G > 0$
46)	A NH_4^+ salt behaves as acidic or basic or neutral properties in 25^0C	Properties of salt depend on the anions that associated with NH_4^+
47)	When amide was reduced basic property will be increased	Alkyl group of amines release the bond pair to N atom that increase the basicity
48)	SO_2 gas can liberated when acidic $K_2Cr_2O_7$ I reduced by H_2S	$K_2Cr_2O_7$ is strong oxidizing agent
49)	Electronegativity of carbon atom of CF_4 is greater than CCl_4 C atom	Electronegativity of surrounding atoms increases as electronegativity of central atom is increases when central atom's hybrization, charge and oxidation stage are equal.
50)	When adding of $NaOH_{(aq)}$ to equal concentration of Mg^{2+}, Ca^{2+} presence solution $Mg(OH)_2$ will precipitate first	A substance with a low Ksp is the first to precipitate always.

தேசிய வளர்க்கள நிலையம் தொண்டைமானாறு
ஐந்தாம் தவணைப் பரீட்சை - 2024

National Field Work Centre, Thondaimanaru.

5th Term Examination - 2024

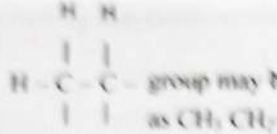
இரசாயனவியல் - II Chemistry - II	Three Hours 10 Min. Gr -13 (2024)	02	E	A

Index No. :- .....

Important:

- Use of calculators is not allowed.
- Universal gas constant, $R = 8.314\ JK^{-1}mol^{-1}$
- Avogadro constant, $N_A = 6.022 \times 10^{23}\ mol^{-1}$
- In answering this paper, you may represent alkyl groups in a condensed manner.

Example :



H H
| |
H – C – C – group may be shown
| | as CH_3CH_2–
H H

❖ **Part – A – Structured Essay (Pages 2 - 8)**

- Answer **all** questions on the questions paper itself.
- Write your answer in the space provided for each questions. Please note that the space provide is sufficient for the answer and that extensive answers are not expected.

❖ **Part B and C - Essay (pages 1 - 7)**

- Answer **four** questions selecting **two** questions from each part. Use the papers supplied for this purpose.
- At the end of the time allotted for this paper, tie the answer to the two parts **A**, **B** and **C** together so that Part A is on top and hand them over to the supervisor.
- You are permitted to remove **only** part **B** of the question paper from the Examination Hall.

For Examiner's Use Only

Part	Question No.	Marks
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
	8	
	9	
	10	
Total	In numbers	
	In Letters	

Code Numbers

Marking Examiner 1	
Marking Examiner 2	
Checked by :	
Supervised by :	

Part - II (A)

Structured Essay

- **Answer all four questions on this paper itself**
- **Each question carries 100 marks**

01)

A. Answer the questions given below in the space provided.

I. Red line in Balmer series is obtained by the election transition between

I $n = 5 \rightarrow n = 2$ *II* $n = 4 \rightarrow n = 2$ *III* $n = 3 \rightarrow n = 2$

.....

II. Of the three anions S^{2-}, Cl^- *and* F^-, which one has the highest polarizing ability.

.....

III. Having Electron in the last orbital which has the quantum number set $n = 3, l = 1, m_l = 0, m_s = +\frac{1}{2}$

C / Si /K

.....

IV. Allotrope of carbon having SP^2 hybridized C atoms.

Diamond / Graphite / Fullerene

.....

V. Of the three compounds NF_3, NH_3 *and* NCl_3, which one has the highest dipolar moment.

.....

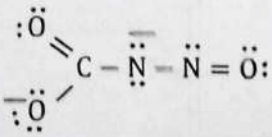
B.

I. Draw the most acceptable Lewis dot-dash structure for SO_4F^-

[*Here S* is in +6 oxidation state and SP^3 hybridization. With that two O atoms are in -1 oxidation state]

.....

II. An acceptable Lewis dot-dash structure for $CO_3N_2^{2-}$ is given below. Draw 3 more structures for this molecule.



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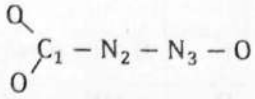
III. Re-Draw the given above structure for $CO_3N_2^{2-}$ by denoting the approximate bond angles.

.....

IV. Give the oxidation states for C_1, N_2 *and* N_3 in the structure given above. And arrange them in the increasing order of their electronegativity.

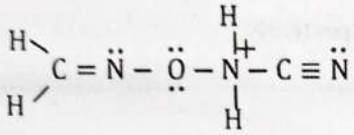


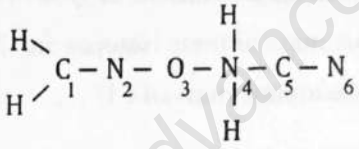
C_1 ..... N_2 .....

N_3.....

Electronegativity .....<.....< .....

V. Complete the chart given based on the following Lewis dot-dash structure and its labeled skeleton.





	C_1	N_2	O_3	N_4	C_5
VSEPR pairs around the atom					
Electron pair geometry around the atom					
Shape around the atom					
Hybridization of the atom					

VI. Identify the atomic/ hybridized orbitals involved in the formation of the σ bonds between the atoms given below.

i. $H - C_1$ H ..... C_1 .....

ii. $C_1 - N_2$ C_1 ..... N_2 .....

iii. $N_2 - O_3$ N_2 ..... O_3 .....

iv. $O_3 - N_4$ O_3 ..... N_4 .....

v. $N_4 - C_5$ N_4 ..... C_5 .....

vi. $C_5 - N_6$ C_5 ..... N_6 .....

VII. Identify the orbitals involved in the formation of π bonds between the atoms given below.

i. $C_1 - N_2$ C_1 ..... N_2 .....

ii. $C_5 - N_6$ C_5 ..... N_6 .....

C_5 ..... N_6 .....

C. Elements that belong to the same period and two different group can form a molecule with the same molecular formula MF_4. Identify molecular shape and the suitable molecule for MF_4 in the given I & II

		Shape	Example
I.	If MF_4 is Non-Polar		
II.	If MF_4 is Polar		

III. Underline the correct word

In the examples you stated above, Molecule having all atoms in same plane is only one/ Both / None of the two

D. Chlorine exists in nature consists of 75% of $^{35}_{17}Cl$ and 25% of $^{35}_{17}Cl$.

Relative atomic mass of these isotopes are $35u$ and $37.0025u$ respectively.

I. What is the atomic mass of Cl? .....

.....

II. What is the average relative atomic mass of Cl? .....

02)

A. Some statements are given related to the following four compounds. Mark whether the statements are true (√) or false (X).

1. KIO_3

I. It can act as an oxidizing agent ( )

II. It reacts with KI by forming KI_3 in acidic medium ( )

III. I is in Sp^2 hybridization state ( )

IV. It gives blue colour in flame test ( )

2. $Na_2S_2O_3$

I. It can act as an reducing agent. During this S is in two different oxidation states 0 and +5 ( )

II. It gives unstable black precipitate with Pb^{2+} ( )

III. When reacting with HCl , S involves to disproportionate and becomes S and SO_2 ( )

IV. It gives yellow colour in flame test ( )

3. H_2SO_4

I. It can act as a base ( )

II. It gives SO_2 as a product when acting as a oxidizing agent ( )

III. It forms an electrophile when reacting with HNO_3 ( )

IV. It gives $NaHSO_4$ as a product when reacting with NaOH . ( )

4. $Pb(NO_3)_2$

I. It gives a thermally stable yellow precipitate with KI ( )

II. When heating with Al, NaOH, NH_3 gas is released by consuming 16 electrons for a molecule of this compound ( )

III. It can be reduced as No with Fe^{3+} in acidic medium ( )

IV. It can give a stable white precipitate with excess NaOH ( )

B. Give the balanced chemical equations for the following reactions of NH_3. And state whether NH_3 acts as a oxidizing agent/ Reducing Agent / Acid / Base

I. $Li + NH_3 \rightarrow$ .....

$NH_3 \leftrightarrow$ .....

II. $Cl_2 + NH_3 \rightarrow$ .....

$NH_3 \leftrightarrow$ .....

III. $CuO + NH_3 \rightarrow$ .....

$NH_3 \leftrightarrow$ .....

IV. $HNO_3 + NH_3 \rightarrow$ .....

$NH_3 \leftrightarrow$ .....

C. Given below are the observations obtained when these chemical species react with the components in the list. Select an appropriate one from the list for each observations.

I. Dark Red colour solution with Fe^{3+} .....

II. Gives colourless, odourless gas immediately when adding a small amount of HCl

.....

III. Gives Reddish Brown precipitate with Cu^{2+} .....

IV. Gives precipitate with $AgNO_3$ which is insoluble in con NH_3 . .....

V. Gives blue colour with $K_3[Fe(CN)_6]$ .....

VI. Gives yellow colour solution as a product with H_2O_2 in the presence of NaOH.

.....

Na_2CO_3 , $NaHCO_3$, NH_4SCN, $FeCl_2$, $FeCl_3$, Cr_2O_3, MnO_2, $K_4[Fe(CN)_6]$, $K_3[Fe(CN)_6]$, K_2MnO_4, $KMnO_4$, KI

i. Give the formula for the products obtained in I, III, V and VI

I - ..... III - .....

V - ..... VI - .....

03)

A. $25\ cm^3$ of NaOH with the concentration of 0.2M is added to the $25\ cm^3$ of 0.2M concentrated $C_2H_5COOH_{(aq)}$

I. Give the reaction that occurs. [$K_a = 1.25 \times 10^{-5} moldm^{-3}$, $K_w = 1 \times 10^{-4} mol^2dm^{-6}$]

.....

II. Give the hydrolysis reaction of the salt obtained as a product.

.....

III. Calculate the pH value of the resultant solution.

.....

.....

.....

.....

.....

IV. Find the pH value when $10\ cm^3$ of 0.1M HCl is added to the above resultant solution.

.....

.....

.....

.....

V. Does the solution obtained in IV above show buffer nature. Explain.

.....

.....

VI. What is the pH of resultant solution after $50\ cm^3$ of 0.1M HCl is added to the resultant solution obtained in I above?

.....

.....

.....

.....

VII. Does it show buffer nature. Explain.

.....

.....

B. $50\ cm^3$ of 0.5M Na_2SO_4 is mixed with $50\ cm^3$ of 0.5M $BaCl_2$ solution.

I. Find the concentration of Ba^{2+}, SO_4^{2-} ions in the resultant solution.

[$Ksp_{(BaSO_4)} = 1.6 \times 10^{-13} mol^2dm^{-6}$]

.....

.....

.....

.....

.....

II. If $15\ cm^3$ of 0.5M Na_2SO_4 is added to $10\ cm^3$ of 0.5M $BaCl_2$, then what is the concentration of Ba^{2+} in the resultant solution?

.....

.....

.....

.....

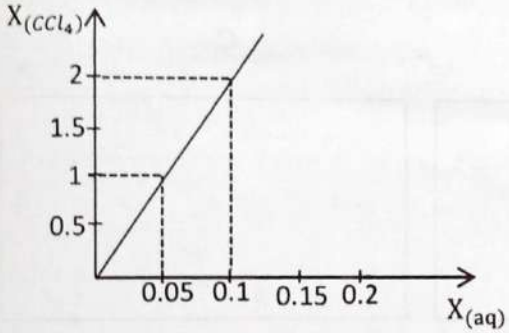
.....

III. Give the assumptions you have made in above calculation.

.....

.....

C. Solute X can be distributed among CCl_4 and water. At 25^0C, Various amounts of X were dissolved and $[X_{(aq)}]$ vs $[X_{(CCl_4)}]$ graph.



I. Obtain the relationship between gradient and partition co-efficient.

.....

.....

.....

.....

II. Calculate the partition co-efficient of X between CCl_4 and water.

.....

.....

.....

.....

III. $X_{(aq)} \rightleftharpoons X_{CCl_4}$ If $\Delta H > 0$

Denote the trend of the graph if this experiment was carried out at 30^0C in the same graph

04)

A. A, B, C and D are four isomers having the molecular formula $C_4H_8O_2$. Only A and B give CO_2 gas by reacting with $NaHCO_3$. C and D does not react with $NaHCO_3$ or Na. When hydrolyzing the products which are formatted by treating these four with $LiAlH_4$, A gives E as a product. When the product obtained by adding con H_2SO_4 to E is allowed to react with HBr, an optically active F is obtained as a product. B is reduced as G. D reduced as CH_3OH and $CH_3CH_2CH_2OH$ and C reduced as CH_3CH_2OH only one product. C and D are functional isomers for A and B. Draw the structure of A, B, C, D, E, F and G in the given boxes.

A

B

C

D

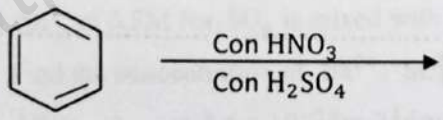
E

F

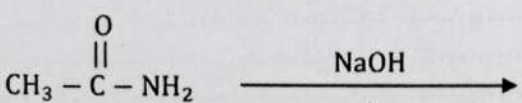
G

B. Draw the products for the reactions given below.

I.

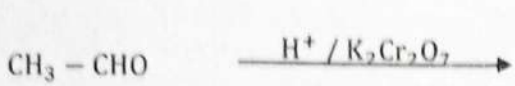


II.

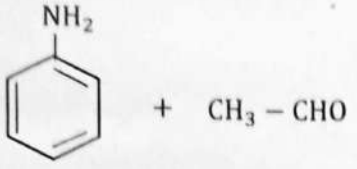


III.

IV.



V.



C.

I. C_2H_5OH involves in Nucleophilic addition reaction with CH_3COOH and gives an unstable intermediate X. Give the structure of X

II. Gives the stable product Y obtained by loosing water from X.

III. Give both products which are obtained by heating Y with NaOH.

தேசிய வெளிக்கள நிலையம் தொண்டைமானாறு
ஐந்தாம் தவணைப் பரீட்சை - 2024
National Field Work Centre, Thondaimanaru.
5th Term Examination - 2024

இரசாயனவியல் - II Chemistry - II	Gr -13 (2024)	02	E	B

Part B – Essay

❖ **Answer two questions only. [Each question carries 150 marks]**

05) (a) (i) When 4g $NaOH_{(s)}$ is mixed with 100 cm^3 of 1M HCl, the temperature of the solution is increased by 15.5^0C

(ii) When 100 cm^3 of 1M $NaOH_{(aq)}$ is allowed to react with 100 cm^3 of 1M HCl, the temperature of the solution is increased by 6.67^0C

[Specific heat capacity of solution 4.5 $Jg^{-1}{}^oC^{-1}$, density 1 gcm^{-3}]

i. Find the enthalpy change when 1mol $NaOH_{(s)}$ reacts with 1mol $HCl_{(aq)}$

ii. Find the enthalpy change when 1mol $NaOH_{(aq)}$ reacts with 1mol $HCl_{(aq)}$

$NaOH_{(s)}$ + water → $NaOH_{(aq)}$

iii. Find the standard enthalpy change of this reaction.

iv. $NaOH_{(s)}$ + water → $NaOH_{(aq)}$ if $\Delta S^0 = +20 Jmol^{-1}K^{-1}$ find ΔG^0 of this reaction.

(b) A and B are two volatile liquids that can form an ideal solution. When a solution of A and B is equilibrium with its vapour, the mol ratio of A : B is found to be 1 : 6 in the liquid phase.

$P_A^0 = 5.6 \times 10^4$ Pa $\quad P_B^0 = 2.1 \times 10^4$ Pa

(i) Find the partial pressure of A and B.

(ii) Find the total pressure.

(iii) Calculate the mol ratio of A and B in the vapour phase.

(iv) Draw the boiling point - composition graph of A and B and mark the followings.

1. If the above mentioned solution having composition A : B = 1 : 4 boils at T_1 temperature, mark T_1 in the graph.
2. Mark the composition of vapour as X_1 which is released by boiling at T_1
3. Mark the composition of solution which is obtained by condensing X_1 as Y_1.
4. Mark the temperature at which Y_1 begins to boil as T_2.
5. Mark the composition of vapour that is released by boiling at T_2 as X_2.
6. What will be the vapour composition at the end, in this procedure is done again and again?
7. Give the composition of the final residue in the distillation flask.
8. Can C_2H_5OH and H_2O be seen as two components of the above. Explain.

(c) $A_{(g)}$ is found inside a rigid container at 601K with initial pressure 2×10^5 Pa . In a short time, $A_{(g)}$ decomposes as following.

$$A_{(g)} \rightleftharpoons 2B_{(g)}$$

Pressure was found to be 3×10^5Pa at equilibrium.

[At 601K, $RT = 5 \times 10^3 Jmol^{-1}$]

(i) Calculate the concentrations of $A_{(g)}$ and $B_{(g)}$ at equilibrium.

(ii) Find the equilibrium constant K_{c1}

(iii) Hence find K_p

(iv) $B_{(g)} \rightleftharpoons C_{(g)} + D_{(g)}$. If the equilibrium constant K_{c_2} of this equilibrium reaction is 6 $molm^{-3}$ then find the equilibrium constant K_{c_3} of the following reaction.

$A_{(g)} \rightleftharpoons 2C + 2D$

06) (a)

I. Prove that pH of a system containing $NH_4OH_{(aq)}$ and $NH_4Cl_{(aq)}$ is given by,

$$pH = PK_w - PK_b + log \frac{[NH_4OH_{(aq)}]}{[NH_4Cl_{(aq)}]}$$

II. Find the pH of resultant solution if 0.214g solid $NH_4Cl_{(s)}$ is mixed with a 100 cm^3 sample of 0.025M $NH_4OH_{(aq)}$ solution. [N = 14, H = 1, Cl = 35.5] K_b of NH_3. $1 \times 10^{-5} moldm^{-3}$

III. Is the possible for a precipitate to form it 50 cm^3 of 1625ppm concentrated $FeCl_3$ solution is added to the 50 cm^3 sample of above solution having NH_4OH, NH_4Cl? [Fe = 56, Cl = 35.5] [$Ksp_{Fe(OH)_3} = 1.2 \times 10^{-16} mol^4 dm^{-12}$]

(b) $CH_{4(g)} + H_2O_{(g)} \rightarrow CO_{(g)} + 3H_{2(g)}$

The above reaction occurs at T temperature inside a rigid container.

I. Give the reaction rates relative to all four compounds.

II. When 100mol $CH_{4(g)}$ and 80mol $H_2O_{(g)}$ were allowed to react inside a 100 dm^3 container, 60 mol of $CH_{4(g)}$ remained after 500 seconds. Find the average reaction rate of $CH_{4(g)}$

III. Find the average reaction rates of H_2O, CO and H_2

IV. When the concentration of $CH_{4(g)}$ is increased by 2 times without changing the concentration of $H_2O_{(g)}$ in this experiment, reaction rate also increased by 2 times. Similarly, when the concentration of $H_2O_{(g)}$ is decreased by 4 times by keeping $CH_{4(g)}$ as constant, reaction rate also decreased by 4 times. Then find the reaction orders of A and B

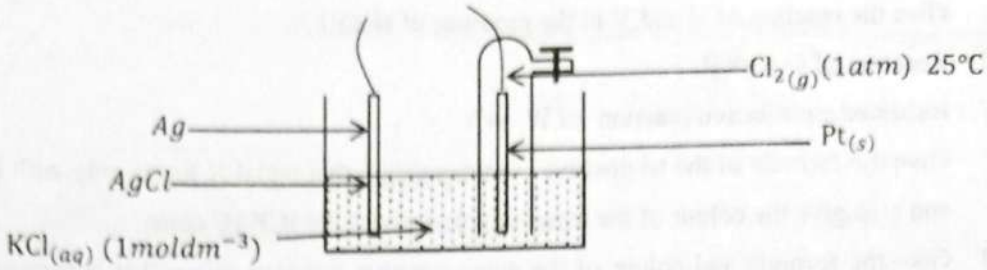
V. This reaction occurs through the following mechanism.

Step I $CH_{4(g)} + H_2O_{(g)} \rightleftharpoons CH_3OH_{(g)} + H_{2(g)}$ - Fast

Step II $CH_3OH_{(g)} + H_{2(g)} \rightarrow CO_{(g)} + 3H_{2(g)}$ - Slow

If so, prove that the above mechanism occurs according to the reaction law

07) (a)



An electrochemical was prepared as shown above.

$E^0_{Ag_{(s)}}, AgCl_{(s)} / Cl^-_{(aq)} = +0.22V$

$E^0_{Cl_{2(g)}} / Cl^-_{(aq)} = +1.36V$

I. Write down the reduction half reaction of the above cell.

II. Write the oxidation half reaction.

III. Write the overall cell reaction.

IV. Find the standard electromotive force of this cell by using given E^0 values.

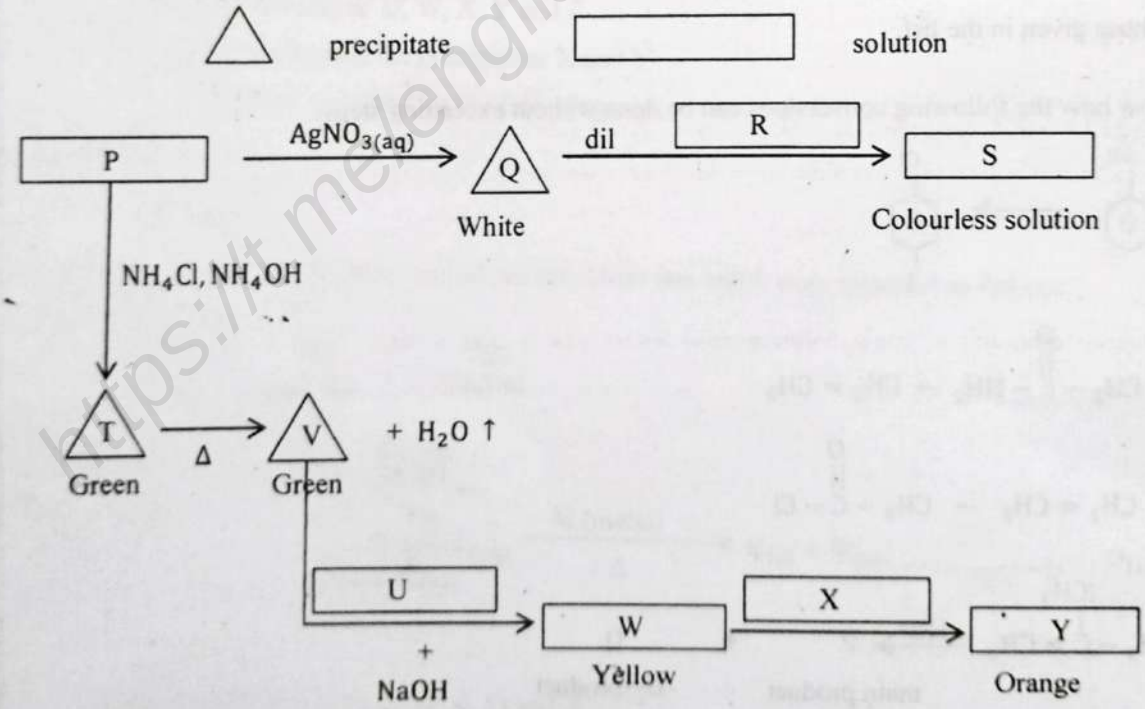
V. Give the IUPAC of this cell.

VI. Does the electromotive force of this cell depends on the concentration of Cl^- ? Explain.

VII. What will be the mass change in Ag, AgCl electrode after 0.1A electric current was obtained for 96.5 minutes from the above cell?

[Faraday constant F = 96500 $Cmol^{-1}$, Ag = 108, Cl = 35.5]

(b) When a transition element salt X was mixed with distilled water, a coloured complex P was formed. It undergoes following series of reaction



I. Identify P, Q, R, S, T, V, U, W, X and Y

II. Give the reaction of U and V in the presence of NaOH.

III. Reaction of Q with R.

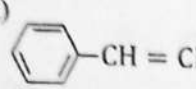
IV. Balanced equilibrium reaction of $W \rightleftharpoons Y$

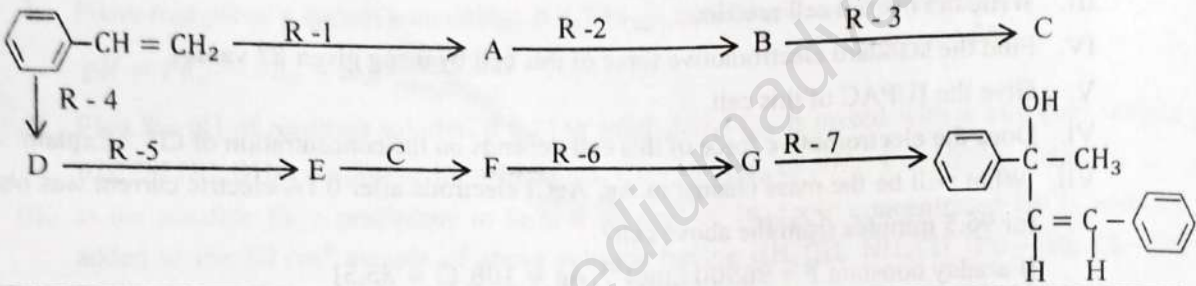
V. Give the formula of the tri positive complex cation that metal X forms only with H_2O molecules and also give the colour of the aqueous solution and the IUPAC name.

VI. Give the formula and colour of the mono positive complex cation that is formed by this metal cation in the solution containing only H_2O and Cl^-

Part - C – Essay

❖ **Answer two questions only. [Each questions carries 150 marks]**

08) (a)  was changed as compound H by the following reaction series.



dil H_2SO_4 , $Br_{2(CCl_4)}$, KOH , C_2H_5OH , Na , PCC , H_2 , Pd $BaSO_4$, Quiroline

Draw the structures of compounds A - G and write the appropriate reagents for steps I - VII, select only from those given in the list.

(b) Show how the following conversions can be done without exceeding steps.

i) 

ii) $CH_3 - \overset{\overset{O}{\|}}{C} - NH_2 \rightarrow CH_2 = CH_2$

iii) $CH_2 = CH_2 \rightarrow CH_3 - \overset{\overset{O}{\|}}{C} - Cl$

(c) $CH_3 - \overset{\overset{CH_3}{|}}{C} = CH_2 \xrightarrow{HBr}$ P (main product) + Q (By-product)

Give the structures of P and Q, And give reasons for why P is obtained as a main product.

(a) Following chemical substance were found in two systems. [Not in order] Following experiments were done to identify them.

System 1

$Na_2S_2O_3$, $AgNO_3$, KI , K_2CrO_4, NaCl , Na_2SO_4

They were labeled as A , B, C, D, E, F [Not in order]

System 2

They were labeled as NaBr , $Pb(NO_3)_2$, $BaCl_2$, HCl ,it P, Q, R and S [Not in order]

A + P → No change

A + S → Turbid solution + Gas with pungent odour

A + Q → White precipitate turned black when heated.

B + S → White precipitate (U)

B + R → White precipitate (U)

B + Q → No change

D + Q → Yellow precipitate (W)

C + Q → Yellow precipitate (X)

D + B → Yellow precipitate (Y)

E + P → No change

F + S + R → White precipitate (Z)

I. Identify the solutions labeled as A, B, C, D, E and F

II. Identify the solutions labeled as P, Q, R and S

III. Identify the precipitates U, W, X, Y and Z

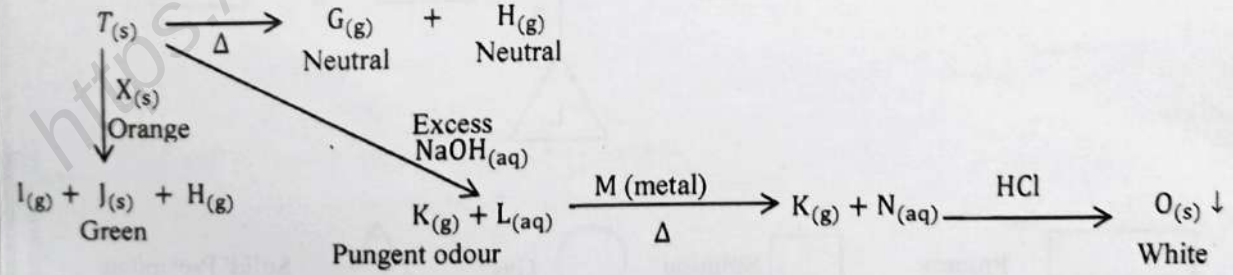
IV. How can we distinguish the precipitates X and Y

V. Give the balanced reactions for the followings.

A + S →

A + Q →

(b) The results of the experiment carried out for colour less salt P were obtained as follows,



I. Identify T, G, H, I, J, K, L, M, N, O and X

II. Give the reactions for the followings.

(i) $T_{(s)} \xrightarrow{\Delta}$

(ii) $T_{(s)} + NaOH \xrightarrow{\Delta}$

(iii) $L + M + OH^- \longrightarrow$

(c) 5g of a solid impure sample made of $FeSO_3$ and $CuSO_3$ was completely mixed with 50 cm^3 of dil H_2SO_4. The released gas was allowed to react fully with 50 cm^3 of 0.5M acidic $K_2Cr_2O_7$ solution. 37.5 cm^3 of 2.4M Fe^{2+} solution was needed to titrate the remaining $K_2Cr_2O_7$

When 5g sample was mixed in acid and to titrate the remaining solution with 0.0667 M $K_2Cr_2O_7$,its 40 cm^3 was needed.

I. Give the reactions of SO_2 with $Cr_2O_7^{2-}$ and Fe^{2+} and $Cr_2O_7^{2-}$

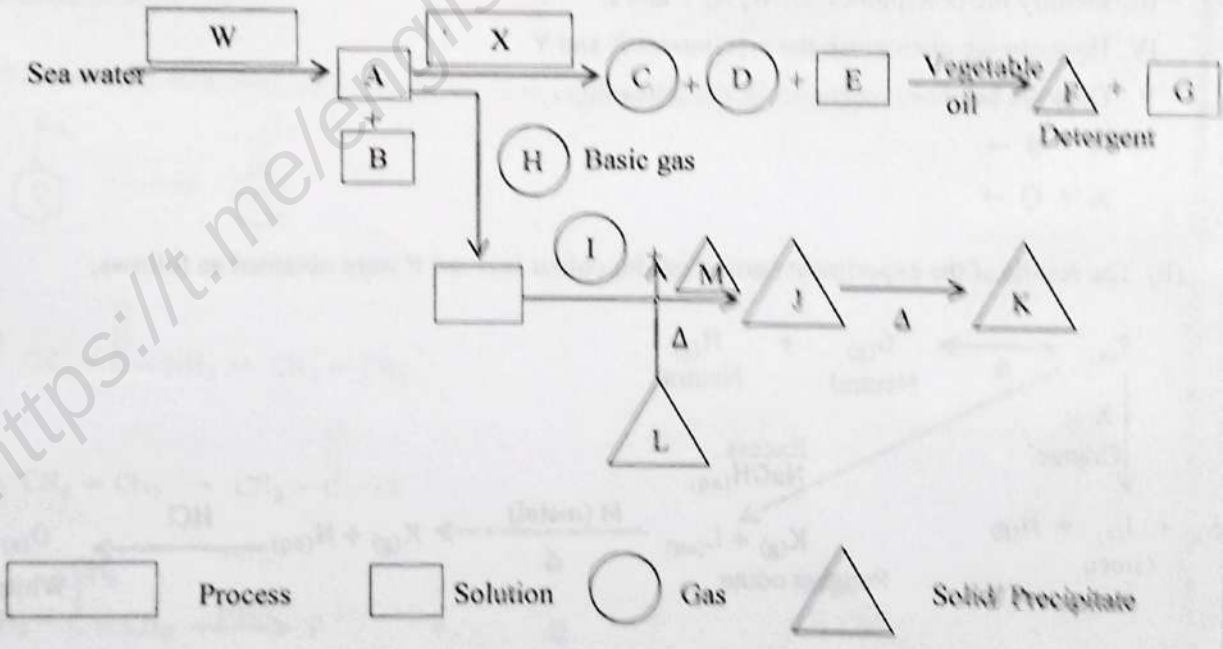
II. Give the reactions of $CuSO_3$ and $FeSO_3$ with dil H_2SO_4

III. Find the mass percentage of $CuSO_3$ and $FeSO_3$.

IV. Find the mol ratio of $CuSO_3$ and $FeSO_3$

[Cu – 64, Fe – 56, S – 32, O – 16] .

09) (a) Flow chart of some chemical substances which are produced by having sea water as raw material is given below.



I. Write the name of the process where K is produced from A.

II. Give the process W and X

III. Identify A - L

IV. Give the half-cell reactions for the formation of gases C and D and also give the suitable electrodes.

V. Give the reaction for the formation of F

VI. Give some uses of G

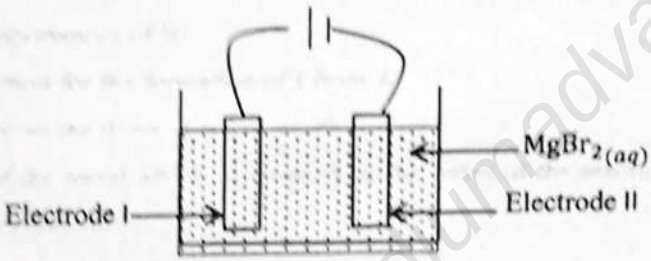
VII. Give the uses/ importances of B

VIII. Give the net reaction for the formation of J from A

IX. How can gas H meet the demand at low cost?

X. Give the name of the metal which is obtained by the series of the reactions when M is added to B and also give the name of this process.

(b) A white precipitate begins to form when $100\ cm^3$ of $0.05\ moldm^{-3}$ $MgBr_2$ aqueous solution is electrolyzed by using pt electrodes and by passing 0.1A electric current for 96.5 seconds as shown in the figure.



I. Identify the anode and cathode and give the reactions that occur there.

II. Find the Ksp of $Mg(OH)_2$

III. If 50 cm^3 sample of $0.05\ moldm^{-3}$ $MgBr_{2(aq)}$ is electrolyzed by using the same electrode and same amount of current, does there will be a change in time for the precipitate to form? Explain.