தொண்டைமானாறு வெளிக்கள நிலையம் நடாத்தும்
நான்காம் தவணைப் பரீட்சை - 2022
Conducted by Field Work Centre, Thondaimanaru.
4th Term Examination - 2022

FWC

| இரசாயனவியல் I | Two Hours | 02 E I |
| Chemistry I | Gr -13 (2022) | |

Part – I

1) Consider the following statements I and II.

   I. The radiant form a metal behave like a stream of tiny energy packets.

  II. The energy can be either released or absorbed by atoms only in discrete quantities of some minimum size.

   1. Albert Einstein and De Broglie   *2.* De Broglie and Max plank

   3. Albert Einstein and Max plank   *4.* Albert Einstein and Niels Bohr

   5. Niels Bohr and Max plank

2) The number of electron in the chromium atom (Cr, Z = 24) that have quantum numbers $l = 0$ and $m_l = 1$ respectively are

   1. 7 and 4   *2.* 7 and 6   *3.* 7 and 5

   4. 6 and 4   *5.* 6 and 5.

3) The decreasing order of radii of species N, N^{-3} , Al , S and S^{-2} is

   1. $S^{-2} > S > N^{-3} > Al > N$ *2.* $S^{-2} > S > Al > N^{-3} > N$

   3. $S^{-2} > N^{-3} > Al > S > N$ *4.* $S^{-2} > N^{-3} > Al > S > N$

   5. $S^{-2} > Al > N^{-3} > S > N$

4) Electron pair geometry and shape of molecule XeO_4 are respectively.

   1. Octahedral and square planner   *2.* Octahedral and square pyramidal

   3. Square planner and octahedral   *4.* Square planer and square pyramidal

   5. Square planner and See - saw

5) IUPAC name of the following compound

$$HO - \overset{\overset{\textstyle O}{\|}}{C} - CH_2 - C \equiv C - \underset{\underset{\textstyle OH}{|}}{CH} - \underset{\underset{\textstyle CH_3}{|}}{CH} - CH_3$$

   1. 5 – hydroxy – 6 – methylhept – 3 – yneoic acid.

   2. 5 – hydroxy – 6 – methylhept – 3 – ynoic acid

   3. 5 – hydroxo – 6 – methylhept – 3 – ynoic acid

   4. 3 – hydroxy – 2 – methylhept – 4 – ynoic acid

   5. 3 – hydroxy – 2 – methyl – 4 – yneoic acid
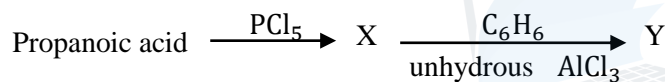
6) Which of the following gives correct oxidation state and hybridization of N atom in NO_2F molecule

1. +4 , SP^2 2. +4 , SP^3 3. +5 ,SP 4. +5, SP^3 5. +5 , SP^2

7) A toy balloon can be inflated to a maximum volume of 300 ml at 1×10^5 Pa pressure. At the same pressure air was pumped into the balloon at 7^0C to a volume of $250\ cm^3$. At what minimum temperature will the balloon burst?

1. 336^0C 2. 63^0C 3. 60^0C 4. 333^0C 5. 58^0C

8) What is the total number of electrons exchanged in the reaction of the reduction of $CH_3CH = CHCH_3$ to $CH_3CH_2CH_2CH_3$ using H_2 gas in the presence of Ni catalyst is

1. 2   2. 4   3. 6   4. 8   5. 10

9) For the combustion of gasoline (C_8H_{18}) in an automobile, the sign of ΔH , ΔS and ΔG will be

1. (+) , (-) , (+)   2. (-) , (-) , (+)   3. (+) , (+) , (-)   4. (-) , (+) , (-)   5. (-) , (-) , (-)

10) Identify Y in the following sequence.

Propanoic acid $\xrightarrow{PCl_5}$ X $\xrightarrow[\text{unhydrous}\quad AlCl_3]{C_6H_6}$ Y

1. $C_6H_5 - CH_2CH_2CH_3$ 2. $C_6H_5 - CH_2CH_3$ 3. $C_6H_5 - \overset{\overset{\displaystyle O}{||}}{C} - CH_3$

4. $C_6H_5CH = CH - CH_3$ 5. $C_6H_5 - \overset{\overset{\displaystyle O}{||}}{C} - CH_2CH_3$

11) What is the correct decreasing order of tendency to undergo nucleophilic addition reaction in the following compounds
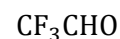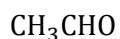
HCHO	CH_3CHO	CH_3COCH_3	CF_3CHO
(A)	(B)	(C)	(D)

1. D > A > B > C   2. D > B > A > C   3. A > B > D > C

4. A > D > B > C   5. B > A > D > C

12) A lamp produce 9.0 J of energy per second in the red region (650 nm) of the visible light. For how long should the lamp be lit to generate 2.0×10^{20} photons?

1. 6.8 S   2. 3.8 S   3. 7.4 S   4. 8.4 S   5. 9.0 S

13) The half life of a first order reaction is 2.50 hours. What is the value of the rate constant in S^{-1}?

1. $0.2772 \times 10^{-5}S^{-1}$ 2. $7.70 \times 10^{-5}S^{-1}$ 3. $9.70 \times 10^{-4}S^{-1}$

4. $8.77 \times 10^{-4}S^{-1}$ 5. $6.47 \times 10^{-4}S^{-1}$

14) For the equilibrium $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$ the total pressure in equilibrium at TK temperature is P and degree of dissociation of $PCl_{5(g)}$ at the same temperature is *x*. Which of the following is the partial pressure of $PCl_{3(g)}$

1. $\frac{x}{x-1}$ x P
2. $\frac{x}{1-x}$ P
3. $\frac{2x}{(1-x)}$ P
4. $\frac{x}{1+x}$ P
5. $\frac{x}{2x-1}$ x P

15) Which of the following statement is incorrect regarding to the chemistry of Group 1 elements.

1. All group 1 elements react with $NH_{3(g)}$.
2. The basic strength of group 1 elements increase down the group.
3. All group 1 elements nitrates dissolve in water.
4. The solubility of group 1 sulfates increase down the group
5. All the oxides of group 1 elements can be obtained on heating their carbonates.
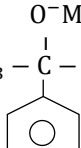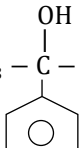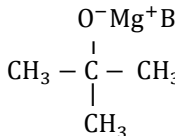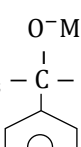
16) Which of the following statement is **false** with regard to the chemistry of chromium (Cr)

1. The oxides of chromium with high oxidation numbers have covalent bonding and its characteristics are acid.
2. Chromium forms two oxyanions and the oxidation state of chromium in that both oxyanions are the same
3. Chromium has six unpaired electrons in its ground state.
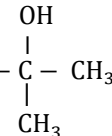4. Chromium has highest melting point among 3d elements.
5. In general solution of chromium complexes are coloured.

17) Consider the reaction of benzene given below.
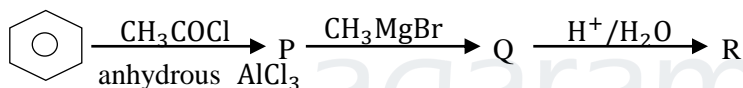
The structures of P, Q and R are respectively.

18) Consider the following equilibrium that exist at a given temperature in a closed container fitted with the valve.

$$2\,SO_{2(g)} + O_{2(g)} \rightleftharpoons 2\,SO_{3(g)}$$

When an additional amount of O_2 gas is introduced through the valve into the container which is the correct regarding the following statements.

1. Initially the concentration of $SO_{2(g)}$ is increased and then it will start to decrease until the equilibrium reach.
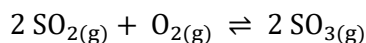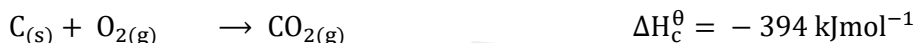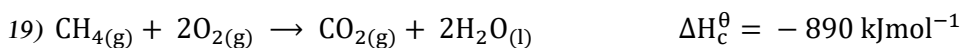
2. Initially the concentration of $O_{2(g)}$ is increased and then it will start to decrease until the equilibrium reach

3. The concentration of $SO_{2(g)}$ will increased.

4. The concentration of $SO_{3(g)}$ will decrease.

5. Concentration of $SO_{2(g)}$ and $SO_{3(g)}$ will not changed.

19) $CH_{4(g)} + 2O_{2(g)} \longrightarrow CO_{2(g)} + 2H_2O_{(l)}$ $\quad \Delta H_c^\theta = -890 \text{ kJmol}^{-1}$

$2\,H_{2(g)} + O_{2(g)} \longrightarrow 2H_2O_{(l)}$ $\quad \Delta H_c^\theta = -286 \text{ kJmol}^{-1}$

$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ $\quad \Delta H_c^\theta = -394 \text{ kJmol}^{-1}$

What is the standard enthalpy change ΔH^θ for the reaction $\quad C_{(s)} + 2H_{2(g)} \longrightarrow CH_{4(g)}$

1. $+76 \text{ kJmol}^{-1}$ 　　　　2. $+82 \text{ kJmol}^{-1}$ 　　　　3. -76 kJmol^{-1}

4. -82 kJmol^{-1} 　　　　5. -56 kJmol^{-1}

20) What is the H^+ aqueous concentration when 300 cm^3 of weak acid HA of concentration 0.2 moldm^{-3} mixed with 200 cm^3 NaOH solution of concentration 0.10 moldm^{-3} (Ka of HA at the same temperature is $7.2 \times 10^{-4} \text{ moldm}^{-3}$)

1. $7.47 \times 10^{-3} \text{ moldm}^{-3}$ 　　2. $7.69 \times 10^{-3} \text{ moldm}^{-3}$ 　　3. $8.42 \times 10^{-3} \text{ moldm}^{-3}$

4. $6.57 \times 10^{-3} \text{ moldm}^{-3}$ 　　5. $7.00 \times 10^{-3} \text{ moldm}^{-3}$

21) The IUPAC name of $[CrCl(H_2O)_5]Cl_2$ is

1. Pentaaquachloridochromium(III) dichloride 　　2. Chloridopentaaquachromium(III) chloride

3. Pentaaquachloridochromium(III) chloride 　　4. Chloridopentaaquachromium(III) dichloride

5. Pentaquachloridochromium(III) chloride.

22) What is the affroximate times of half life of the first order reaction when 99.9 % of the specific reaction is completed

1. 6 times 　　2. 7 times 　　3. 8 times 　　4. 9 times 　　5. 10 times

23) Equilibrium constant (Kc) of the reaction $H_{2(g)} + C_2H_{4(g)} \rightleftharpoons C_2H_{6(g)}$ at 25^0C is $9.6 \times 10^{18} \text{ mol}^{-1}\text{dm}^3$. If a mixture of 0.200 moldm^{-3} $H_{2(g)}$ and 0.155 moldm^{-3} $C_2H_{4(g)}$ is maintained at 25^0C in the presence of nickel powdered catalyst. What is the equilibrium concentration of C_2H_6 in the mixture at 25^0C (in moldm^{-3})

1. 0.045 　　2. 0.155 　　3. 3.6×10^{-19} 　　4. 0.100 　　5. 0.360

24) A water soluble inorganic compound X is treated with mixture of dil NH_4OH and NH_4Cl gives white colour precipitate A. $BaCl_2$ solution is added to X gives white colour precipitate B. When this precipitate B is treated with dil HNO_3. What is X.

1. $FeSO_4$ 2. $Al_2(SO_3)_3$ 3. $ZnSO_4$ 4. $Al_2(SO_4)_3$ 5. $Cr_2(SO_4)_3$

25) Which is the correct order of increasing acid strength of the following compound
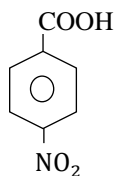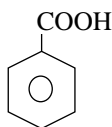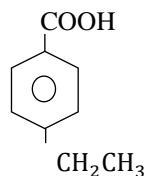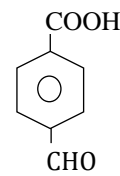
(a)   (b)   (c)   (d)

1. $c < b < a < d$ 2. $c < b < d < a$ 3. $c < d < a < b$ 4. $c < d < b < a$ 5. $d < c < a < b$

26) A suitable method to prepare
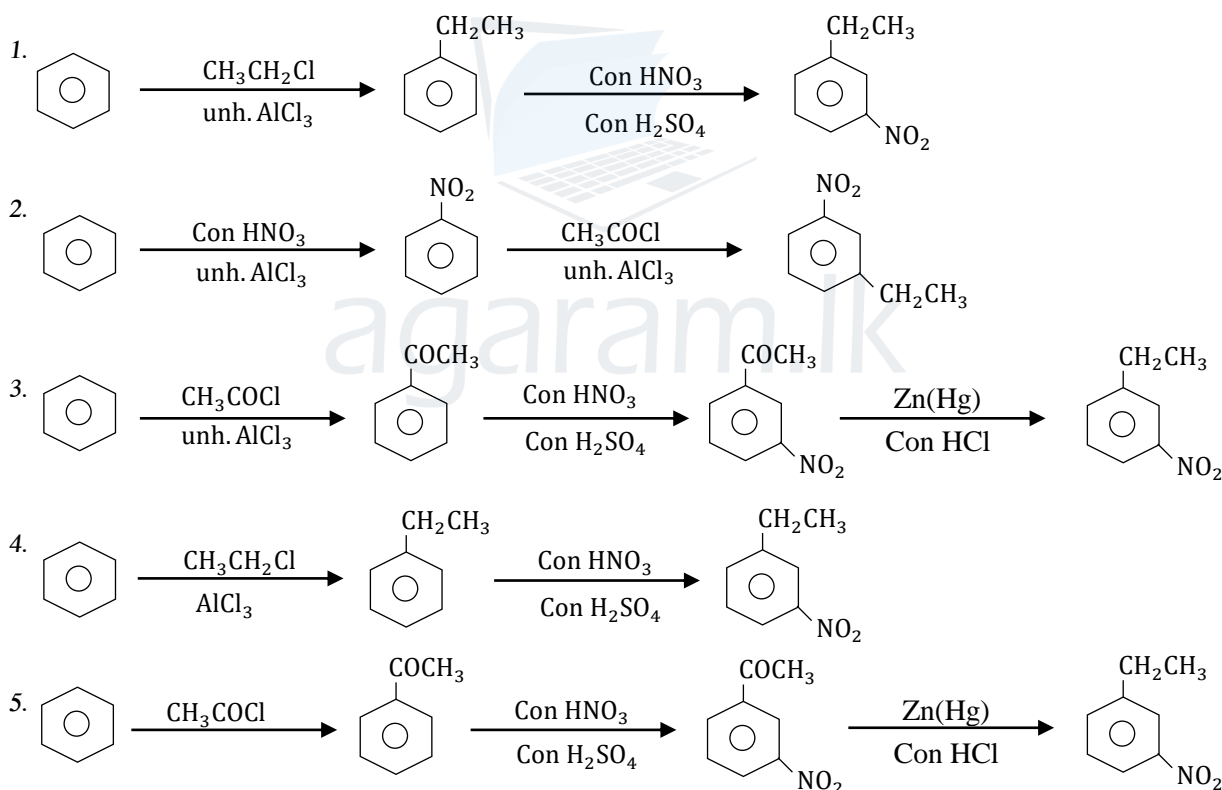
27) Which is the following reagent is more suitable to distinguish $Pb(NO_3)_2, CaSO_4, Na_2S_2O_3$ and $CaCO_3$ solutions separately.

1. $H^+/KMnO_4$ 2. $H^+/K_2Cr_2O_7$ 3. Br_2/H_2O 4. dil HCl   5. all are wrong

28) What are volumes of two stock solutions of concentrations 3 $moldm^{-3}$ and 0.5 $moldm^{-3}$ HCl which have respectively to prepare 1 $moldm^{-3}$ 250 cm^3 HCl solution.

1. 50 cm^3 and 200 cm^3 2. 75 cm^3 and 175 cm^3 3. 100 cm^3 and 150 cm^3

4. 150 cm^3 and 100 cm^3 5. 125 cm^3 and 125 cm^3

29) What is the molar volume of a gas at 25^0C and 101325 Pa pressure ($dm^3 mol^{-1}$)

   1. 22.414   *2.* 23.414   *3.* 24.790   *4.* 24.00   *5.* 20.414

30) What is the false statement regarding catalyst.

   1. Catalyst do not effect the enthalpy of the reaction.

   2. Catalyst do not change the equilibrium point of the reaction.

   3. Catalyst is the substance which increase the rate of the reaction

   4. A catalyst is a substance that accelerate a reaction but undergoes no net chemical changes

   5. Catalyst decrease the activation energy of the reaction.

❖ **For each of the question 31 to 40 one or more response out of four responses (a), (b), (c) and (d) given is / are correct. Select the correct responses / responses. In accordance with the instruction given on your answer sheet mark.**

1	2	3	4	5
Only (a) (b) are correct	Only (b) (c) are correct	Only (c) (d) are correct	Only (a) (d) are correct	The other numbers correct

31) Which of the following statement / s is are true with regarding to halogens?
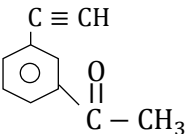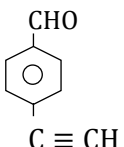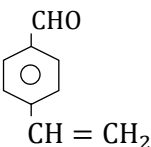
   a) All halogens are good oxidizing agents.

   b) Reactivity of halogens decrease down the group

   c) The boiling point of halogens increase down the group

   d) All halogens have more than two different oxidation numbers.

32) For the reaction $PbCO_{3(s)} \rightleftharpoons PbO_{(s)} + CO_{2(g)}$ occurring in a closed rigid container percentage yields of $CO_{2(g)}$ at T_1 K and T_2 K ($T_1 < T_2$) are 65 % and 80 % respectively. Which of the following statement / s is / are correct.

   a) Equilibrium can be shifted towards the left by removing $CO_{2(g)}$

   b) This reaction is endothermic

   c) Equilibrium can be shifted towards the right by removing $CO_{2(g)}$

   d) This reaction is Exothermic

33) Which of the following compound / s react / s separately with all 3 reagents.

   (1) Ammonical $AgNO_3$ *(2)* $NaNH_{2(l)}$ *(3)* 2, 4 Dinitrophenylhydrazene

34) Which is / are the expression / s representing the standard enthalpy of atomization.
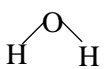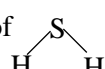
   a) $Br_{2(g)} \rightarrow 2 Br_{(g)}$ b) $Al_{(s)} \rightarrow Al_{(l)}$ c) $\frac{1}{2} Cl_{2(g)} \rightarrow Cl_{(g)}$ d) $Ca_{(s)} \rightarrow Ca_{(g)}$

35) Which is / are the correct statement / s about molecular kinetic theory.

   a) Particles of a gas behave independently of one another.

   b) The average Kinetic energy of gas particles independends on the absolute temperature.

   c) The pressure of a gas arises from the sum of the collision between the gas particles.

   d) The relation of mole of gas particle with the absolute temperature is given by the equation $K_E = \frac{3}{2} RT$

36) Which of the following statements is / are correct with regard to H_2O and H_2S.
   a) Bond pair repulsion of central are stronger in H_2O than in H_2S.
   b) Bond angle of $\overset{O}{\underset{H \quad H}{}}$ is greater than bond angle of $\overset{S}{\underset{H \quad H}{}}$
   c) Acidity of H_2O molecule is greater than acidity of H_2S molecule.
   d) Boiling point of H_2O is greater than H_2S

37) Which is the correct statement / s about the molecularity of a reaction.
   a) In general molecularity of a simple reaction is equal to the sum of the number of reactants involved in the balance stoichiometric equation
   b) When multi – step reaction mechanism is written number of reacting particles that comes together or collide in the rate determining step to form a product / s is called molecularity of a reactions.
   c) A reaction is called unimolecular when only a single reactant molecule is involved in that reaction.
   d) molecularity is a theoretical concept.

38) Consider the following compounds.

(a) NH$_2$ ... COOH (b) CH$_2$NH$_2$ ... COOH (c) CH$_2$NH$_2$ ... CH$_3$ (d) COOH ... CH$_3$
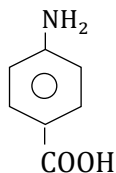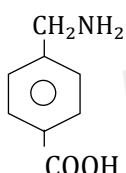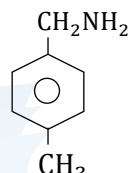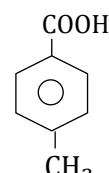
   What compound /s show all of the following observations.
   1. Liberates $CO_{2(g)}$ with (air bubble) Na_2CO_3 solution
   2. Liberates $H_{2(g)}$ (air bubble) with Na.
   3. Librate a gas (air bubble) with $NaNO_2$ and dil HCl at 25^0C.

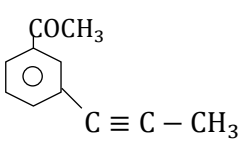39) Which of the following statement / s is / are true regarding a homogeneous chemical reaction system at dynamic equilibrium .
   a) Increase in temperature will not increase the rates of both forward and reverse reaction.
   b) The rate constant of forward and reverse reaction are equal
   c) The concentrations of all components of the reaction are constant at any time.
   d) The Le – chatelier principle can be used to predict the change in the system upon addition of a reactant at constant temperature.

40) Which of the following statement / s is / are true
   a) Electrons have particles as well as wave properties.
   b) All ions have at least one proton.
   c) A proton is heavier than a neutron.
   d) All atoms have electrons protons and neutrons.

❖ **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

	First Statement	**Second statement**
41.	The ionic product of water (Kw) decrease as the temperature is increased.	Dissociation of water is endothermic process.
42.	When KCl is heated with cone H_2SO_4 in the presence of $MnO_{2(s)}$, $Cl_{2(g)}$ gas is produced.	MnO_2 is stronger oxidizing agent then conc. H_2SO_4
43.	Diazonium salt of aromatic compound $(C_6H_5N_2^+Cl^-)$ react with water at 25^0C form phenol .	Diazonium salts can act as nucleophilic reagents.
44.	The order of the reaction $PCl_{5(g)} \rightarrow PCl_{3(g)} + Cl_{2(g)}$ can be determined by monitoring the volume change of the system with a sample of $PCl_{5(g)}$ is heated.	The order of a chemical reaction with respect to a reactant does not depend on the concentration of the reactant.
45.	$\bigodot\!\!\begin{array}{l}CH-NH_2\\ \mid\\ CH_3\end{array}$ is more basic than $\bigodot\!\!CH_2NHCOCH_3$	The ionic pair of electron on the nitrogen atom of an amine is delocalized onto the carbonyl group by resonance
46.	The reaction between NO_2 and NaOH is an example of a disproportionation reaction	When an element or an element in the compound is simultaneously oxidized and reduced is called disproportionation reaction.
47.	ICl_4^- ion is tetrahedral	There are six repulsion units around the iodine atom in ICl_4^- ion
48.	An aqueous solution of Ag^+ and an aqueous solution of Cr^{3+} can be distinguished by using an NH_4OH solution.	Both Ag^+ and Cr^{3+} initially form precipitate, in excess NH_4OH precipitate of Ag^+ dissolve form colourless solution.
49.	Real gas deviate more from ideal behavior at high pressure and low temperature	A real gas molecules has high intermolecular interaction than ideal gas molecules.
50.	The boiling point of butanal is less than the boiling point of 2 – butanone.	Intermolecular interaction of butanal is less than the intermolecular interaction of 2 – butanone.

தொண்டைமானாறு வெளிக்கள நிலையம் நடாத்தும்
நான்காம் தவணைப் பரீட்சை - 2022
Conducted by Field Work Centre, Thondaimanaru.
4th Term Examination - 2022

இரசாயனவியல் **II A**	Three hours 10 minutes	02	E	IIA
Chemistry **II A**	Gr -13 (2022)			

Part – II A

1. (a)   Consider the following chemical species.

NO_2^+ , BF_3 , BrF_5 , K_2CO_3 , HI , $BeCl_2$
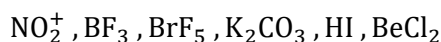
Which of the above species.

(i)   has a π – bond resulted from over lapping of 1S atomic orbital and 5P

orbital   …………………

(ii)   has square pyramid shape   …………………

(iii)   has 5P hybridized central atom but no π bond   …………………

(iv)   has both ionic and covalent bonds   …………………

(v)   Contains a bond angle of 180^0 …………………

(vi)   has electronic configuration as same as NO_3^- …………………

(b)(i) |Draw the most acceptable Lewis structure for the ion SCl_2NO^-

……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………

(ii) The most stable Lewis structure for the molecule CN_2H_2 is shown below. Draw another two
Lewis structures (resonance structures) for this molecules.

$$H - \overset{..}{N} = C = \underset{..}{N} - H$$

……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
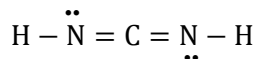
(iii) Using the given Lewis structure and its labelled skeleton structure, complete the given table.

		S^2	N^3	C^4	O^5
I.	VSEPR pairs around the atom				
II.	Electron pair geometry around the atom				
III.	Shape around the atom				
IV.	Hybridization of the atom				

❖ **Question (iv) to (vii) given below are based on the Lewis dot – cross structure given in above part (iii)**

(iv) Identify the atomic / hybrid orbitals involved in the formation of σ bonds between the given pairs of atoms.

  I. $N^1 - S^2$ N^1 …………………… S^2 ……………………

  II. $S^2 - N^3$ S^2 ………………… N^3 ……………………

  III. $N^3 - C^4$ N^3 ………………… C^4 …………………

  IV. $C^4 - O^5$ C^4 ………………… O^5 …………………

  V. $O^5 - H$ O^5 …………………   H ……………………

(v) State the approximate band angles around S^2 , N^3 , C^4 , and O^5 atoms

  S^2 ………………… N^3 ………………… C^4 ………………… O^5 …………………

(vi) Arrange the atoms N^1 , S^2 , N^3 , O^5 in the increasing order of their electro negativities.

  ………………… $<$ ………………… $<$ ………………… $<$ …………………

(vii) Give the oxidation numbers of N^1 , S^2 , N^3 , C^4 and O^5

  N^1 ………… S^2 ………… N^3 ………… C^4 ………… O^5 …………

(c) Arrange the given atoms / ions in order based on the properties given within the brackets.

 I. F^- , Na^+ , Li (Radius)

   ………………… $<$ ………………… $<$ …………………

 II. HCN , CO_2 , $COCl_2$, CH_4 (Electronegativity of C)

   ………………… $<$ ………………… $<$ ………………… $<$ …………………

 III. $MgCO_3$, $CaCO_3$, $SrCO_3$, $BaCO_3$ (Decomposition temperature)

   ………………… $<$ ………………… $<$ ………………… $<$ …………………

 IV. CH_4 , H_2O , NH_3 , HF (Boiling point)

   ………………… $<$ ………………… $<$ ………………… $<$ …………………

 V. LiF, LiCl , LiBr , LiI (Ionic character)

   ………………… $<$ ………………… $<$ ………………… $<$ …………………

2.(a) Elements X and Y are consecutive non transition elements in periodic table. X and Y react with an inert gas Z and form compounds P and Q respectively. P reacts with water and gives a gas R that turns red litmus to blue. X does not react with cold water. But it reacts with steam and gives a Solid S. A compound of X is present in the naturally occurring magnesite ore.

(i) Identify X and Y.

X …………………… Y …………………

(ii) Give the chemical formula of P, Q, R and S

P …………………… Q ………………… R ………………… Q ………………

(iii) Identify the gas Z.

…………………………………………………………………………………………………..

(iv) Give the balanced chemical equation for the reaction of P with water.

…………………………………………………………………………………………………..

(v) Give the balanced chemical equation for the reaction between X and steam

…………………………………………………………………………………………………..

(vi) Give the balanced chemical equation for the reaction of Y with NaOH.

…………………………………………………………………………………………………..

(vii) Give the chemical formulae of the stable ion of Y in aqueous solution.

…………………………………………………………………………………………………..

(viii) What is the observation when small amount of solid Na_2CO_3 is added to the aqueous solution of the above ion.

…………………………………………………………………………………………………

…………………………………………………………………………………………………..

(ix) Explain why first ionization energy of X is greater than that of Y.

…………………………………………………………………………………………………..

(x) Give the chemical formulae of the compound of X present in magnesite ore?

…………………………………………………………………………………………………..

(b) Solids $(NH_4)_2Cr_2O_7$, $(NH_4)_2CO_3$, NH_4NO_3 , $NaNO_3$ and $LiNO_3$ are kept in test tubes labelled form A to E (not in order). Observations related the products released when heating the above solids are given in the chart below.

Solid	Characteristics of the products
A	• White colour powder • Colourless diatomic gas at Room Temperature.
B	• Three gaseous products
C	• Green colour powder • Colourless diatomic gas at Room Temperature.
D	• White colour residue • Colourless diatomic gas at Room Temperature • Brown colour gas
E	• Gas molecule with linear shape • Gas that turns into colour less liquid at Room Temperature.

I. Identify the solids A – E.

A ……………………   B ……………………   C ……………………
D ……………………   E ……………………

II. Give the balance chemical equation for the reactions take place when heating the solids A to E

……

……

……

……

……

……

3. (a) An experiment was carried out to determine the order of the reaction respect to I^-, during the reaction between Fe^{3+} and I^-. Data obtained from the experiment are given below

Exp . No	Distilled water $/ cm^3$	Acidified $0.1\ moldm^{-3}$ $Fe^{3+}_{(aq)} / cm^3$	$3\ moldm^{-3}$ $KI_{(aq)} / cm^3$	$0.006\ moldm^{-3}$ $S_2O^{2-}_{3(aq)}$ + Starch $/ cm^3$	Time taken for the appearance of blue colour
1	0.0	25.0	10.0	15.0	6.4
2	2.0	25.0	8.0	15.0	10
3	4.0	25.0	6.0	15.0	17.7
4	6.0	25.0	4.0	15.0	40
5	8.0	25.0	2.0	15.0	160

I. Give the balanced chemical equation for the reaction between $Fe^{3+}_{(aq)}$ and $I^-_{(aq)}$

…………………………………………………………………………………………………

II. Take **a** as the order of reaction respect to $Fe^{3+}_{(aq)}$, **b** as the order of reaction respect to $I^-_{(aq)}$ and k as the rate constant, write the rate law for the above reaction (R)

…………………………………………………………………………………………………

…………………………………………………………………………………………………

III. When does the blue colour appear for the first time during the experiment?

…………………………………………………………………………………………………

IV. How blue colour appear during the experiment?

…………………………………………………………………………………………………

………………………………………………………………………………………………..

V. Why same amount of $Na_2S_2O_3$ is used throughout the experiment

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

VI. Give the balanced chemical equation for the reaction in which $Na_2S_2O_3$ is involved?

…………………………………………………………………………………………………

VII. Why the volume of $Fe^{3+}_{(aq)}$ is kept constant throughout the experiment?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

VIII. Why acidified $Fe^{3+}_{(aq)}$ is used in the experiment?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

IX. Two different solutions were taken in two different beakers and mixed together to carry out the experiment. Name the two solutions taken in those beakers.

Beaker I :- ………………………………………………………………………………..

Beaker II :- ………………………………………………………………………………

X. Why water is added to the mixture?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

XI. If the time taken for the appearance of blue colour is short, give 3 methods to increase the time duration?

……..

……..

……..

XII. Find the oder of the reaction respect to I^-

……..

……..

……..

……..

……..

……..

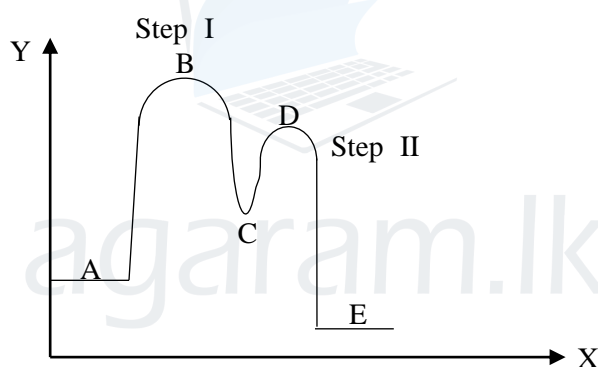……..

……..

(b) The given graph is drawn according to the mechanism of the reaction $(CH_3)_3CCl \xrightarrow{OH^-}$ Products

I. Name X axis and Y axis.

X …………………   Y …………………

II. Give the suitable structures for the chemical species A, B, C, D and E

A …………………   B …………………   C …………………   D …………………

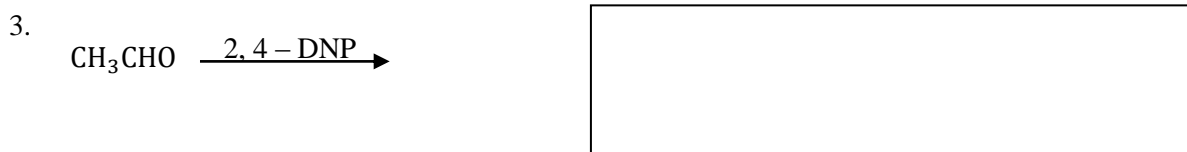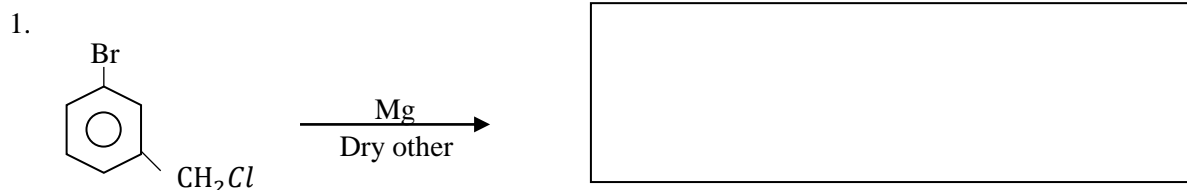III. Which step determines the rate of reaction?

……..

IV. Denote the over all activation energy of the reaction $[E_a]$ in the graph.

V. Give the chemical formulae of the intermediate.

……..

(c) The reaction $2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$ has following mechanisms.

Step I :- $NO_{(g)} + O_{2(g)} \rightleftharpoons NO_{3(g)}$ (Equilibrium constant kc, fast)

$\qquad NO_{3(g)} + NO_{(g)} \rightarrow 2NO_{2(g)}$ (Slow)

Take k as the rate constant and derive the expression for the rate of reaction

……
……
……
……
……
……
……
……
……
……

4. (a) A, B, C, and D are four structural isomers having the molecular formula $C_4H_{11}N$ A Shows optical isomerism A, B, C, D react separately with $NaNO_2$ / dil HCl and from structural isomers E, F, G and H respectively along with N_2 gas. F does not react with H^+ / $KMnO_4$ when G, H are heated separately with Al_2O_3 they form the compounds I and J respectively. When HBr is added to I, J the main products formed are K and L respectively. Only K has optical isomers.

1. Draw the structures A – L the suitable boxes.

A	B	C
D	E	F
G	H	I
J	K	L

(b) Give the products of the reactions given below.

1.

$$\xrightarrow[\text{Dry other}]{\text{Mg}}$$

2.

$$CH_3 - \overset{\overset{\text{O}}{\|}}{C} - CH_2COOH \xrightarrow[\text{methanol}]{NaBH_4}$$

3.

$$CH_3CHO \xrightarrow{2,4-DNP}$$

4.

$$CH_3CH_2NH_2 \xrightarrow{CH_3COCl}$$

5.

$$\xrightarrow[20^0C]{\text{dil } HNO_3}$$

(c) Give the mechanism of the reaction $R - \overset{\overset{\text{O}}{\|}}{C} - Cl \xrightarrow{NaOH}$ Products   (10 Marks)

………

………

………

………

………

………

தொண்டைமானாறு வெளிக்கள நிலையம் நடாத்தும்
நான்காம் தவணைப் பரீட்சை - 2022
Conducted by Field Work Centre, Thondaimanaru.
4th Term Examination - 2022

இரசாயனவியல்	II B				
Chemistry	II B	Gr -13 (2022)	02	E	IIB

Part – II B

❖ **Answer only two questions.**

05) a) $16.628 dm^3$ of $C_2H_{4(g)}$ at $127°C$ temperature and $4 \times 10^5 Pa$ pressure was mixed with $4.157 dm^3$ of $H_{2(g)}$ at $27^0 C$ temperature and $3 \times 10^6 Pa$ pressure, in a rigid vessel of volume $10 m^3$. Then the temperature of the gas mixture was raised to $727°C$. Consider that the gases show ideal behavior.

i) Find the number of moles of $C_2H_{4(g)}$ and $H_{2(g)}$.

ii) Find the total pressure inside the vessel

iii) Find the partial pressure of $C_2H_{4(g)}$

iv) Find the density of the gas mixture in the container.

Then a catalyst of negligible volume was added to the vessel and the system was allowed to react until one of the gaseous reacted completely. Consider the temperature remained constant and find the,

i) Mole fraction of the excess reactant.

ii) Total pressure of the gas mixture.

iii) Density of the gas mixture.

b) i) Find the standard enthalpy change of the following reaction using thermo chemical cycle and data given below.

$$C_2H_5OH_{(l)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_2O_{(l)}$$
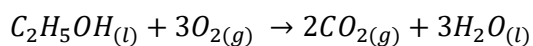
	$\Delta H_f^\theta (kJmol^{-1})$	$S^\theta (Jmol^{-1}k^{-1})$
$C_2H_5OH_{(l)}$	-277.6	161
$O_{2(g)}$	0.0	205
$CO_{2(g)}$	-393.5	214
$H_2O_{(l)}$	-285.8	70

ii) Find the standard entropy change of the reaction given in b (i).

iii) Calculate the standard Gibb's energy change (ΔG^θ) of the above reaction in b (i) at 500 K.

iv) Giving suitable reasons, state whether decrease in the temperature favours the above reaction or not. Consider enthalpy change and entropy change are independent of the temperature.

6) a) i) State Le – chatelier's principle.

   ii) Show how temperature affects the equilibrium of the reaction $2NO_{2(g)} \rightleftharpoons N_2O_{4(g)}$.

   iii) Explain what will happen to the above equilibrium when an inert gas is added to the system while keeping the
   (i) Temperature and volume constant.

   (ii) Temperature and pressure constant.

   iv) Consider the following equilibrium at 400 K.
   $$aP_{(g)} \rightleftharpoons Q_{(g)} + 2R_{(g)}$$
   (i) Give the expressions for K_p and K_c

   (ii) If $K_p = K_c$, then find the value of a.

   (iii) The ratio between the gases P, Q, R are $n_p : n_Q = 3 : 2$ and $n_Q : n_R = 1 : 2$ and the system is $9 \times 10^5 \, Pa$. Then find the Kp of $aP_{(g)} \rightleftharpoons Q_{(g)} + 2R_{(g)}$ and the partial pressure of the gases.

   (iv) Find the moles of P, Q and R when 0.3 moles of $Q_{(g)}$ and 0.6 moles of $R_{(g)}$ are mixed and allowed to reach equilibrium at 400 K.

b) i) Find the pH of $0.5 \, moldm^{-3} \, CH_3COOH_{(aq)}$ solution of volume $100cm^3$.

   ii) What is the pH of the resultant solution when $50cm^3$ of $0.5 \, moldm^{-3} \, NaOH_{(aq)}$ is added to the above aqueous solution.

   iii) What is the pH of the resultant solution at 25^0C when $100cm^3$ of $0.5 \, moldm^{-3} \, NaOH_{(aq)}$ is added to the above (i) aqueous solution.

   iv) Find the pH of the resultant solution when $100cm^3$ of $1 \, moldm^{-1} \, NaOH$ is added to the above (i) aqueous solution.
   $[25^0C, Ka \, [CH_3COOH] = 1.8 \times 10^{-5}] \, [at \, 25^0C \; Kw = 1 \times 10^{-14}]$

7) a) The following graph shows the variation of pH when two monobasic acids HA and HB were titrated with $0.1 \ moldm^{-3} \ NaOH$ solution.
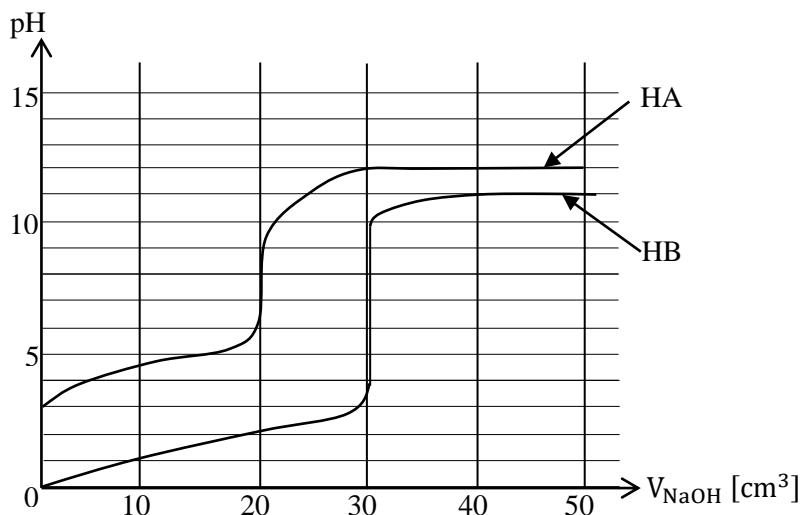
   i) Among HA and HB which is more added? Give reasons.

   ii) Among the above acids, which is more concentrated? Give reason.

   iii) What is the volume of the reacted HA?

   iv) Find the dissociation constant of HA.

   v) Find the pH at the equivalent point of HA. NaOH titration

   vi) Give the indicator that can be used in the above both titration.

b) I) P, Q and R are three coordination complexes. They have an octahedral molecular geometry. Only two of the ligands in each complex P, Q and R are linked to the metal ions. Metal ions in all three complexes have some oxidation number. Molecular formula of the compounds are $CoCl_2H_{12}N_4$, $CoI_2H_{16}N_4O_2$, $CoCl_2H_{15}N_3O_3$ (not in order) Aqueous solution of the above compounds were allowed to react with $(Pb(CH_3COO)_2$ and the observations are given below.

Compound	$Pb \ (CH_3COO)_{2(aq)}$
P	White precipitate that dissolves in hot water.
Q	Not precipitate.
R	Yellow precipitate that dissolves in hot water.

   i. Give the structures of P, Q and R .

   ii. Give the chemical formulae of the precipitates forward during the reaction of P and R with $Pb(CH_3COO)_{2(aq)}$

   iii. Give a test for anion / anions in the above compounds, which is / are not linked with the metal ion.

         (Should not include the tests already given)

II) M is a transition element that forms a coloured complex P in aqueous solution. The general formulae of that complex is $[M(H_2O)_n]^{m+}$. It undergoes the following reactions.

P
- $\xrightarrow[\text{HCl}]{\text{Con}}$ Blue colour solution (Q)
- $\xrightarrow{\text{NaOH}_{(aq)}}$ Pink precipitate (R)
- $\xrightarrow[NH_{3(aq)}]{\text{Excess}}$ Yellowish brown (S) $\xrightarrow{\text{air}}$ Reddish brown (T)
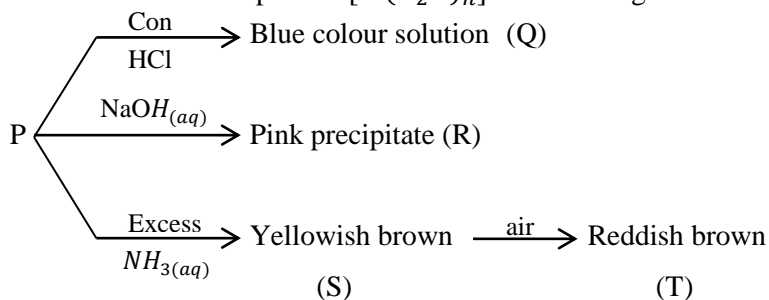
i. Identify the metal M and its oxidation number in the complex P.
ii. Give the electronic configuration of M in the complex P.
iii. Find the value of m and n.
iv. Give the molecular geometry of the complex P.
v. Give the structure of Q, R, S and T.
vi. Give the IUPAC names of the complex ions Q, S and T.

Part - C
Answer only two questions.

08) a) P is converted to W using this reaction scheme given below.

$CH_3CH_2CH_2OH$ $\xrightarrow{(1)}$ Q $\xrightarrow{(2)}$ R

(5) | (P)

U

$\downarrow$ (3)

U $\xrightarrow{(6)}$ V + T $\xleftarrow{(4)}$ S

$$CH_3CH_2CH_2 N = \underset{\underset{CH_3}{|}}{C} - CH_3 \quad (W)$$
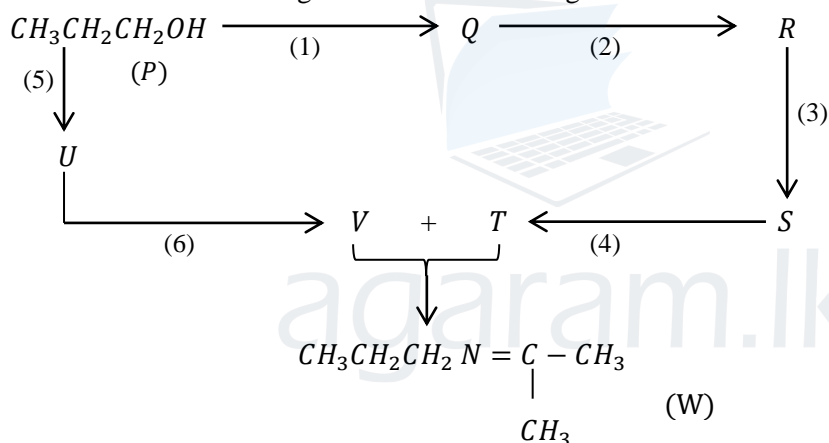
Carryout the above conversion only using the reagents given in the below.

$H^+ / KMnO_4, \ NH_3, \ Con \ H_2SO_4, \ PCl_5, \ HBr, \ KOH$ நீ

b)
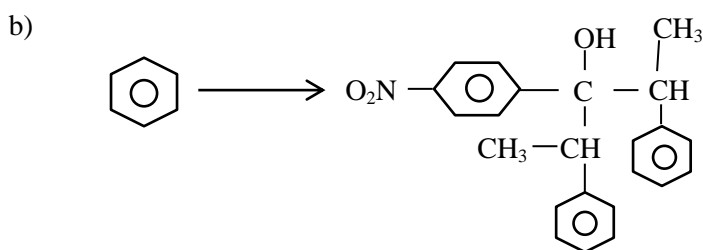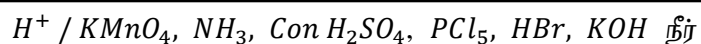
Carryout the above conversion in not more than 10 steps using the reagents given in the box.

$PCl_3, \ Mg \ dry \ ether, \ H^+ / KMnO_4, \ CH_3Cl, \ CH_3COCl, \ $ Anhyd $AlCl_3, \ NaBH_4, \ ConH_2SO_4, \ dil \ H_2SO_4, \ ConHNO_3$
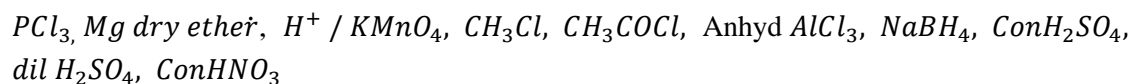
c) Explain why acidity of phenol is greater than the acidity of alcohols (ROH)

09) a) $H_2SO_{4(l)}$ was added to a metal X and the following reactions were carried out.
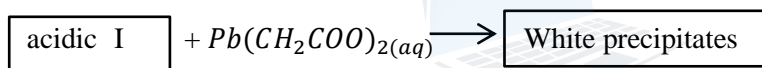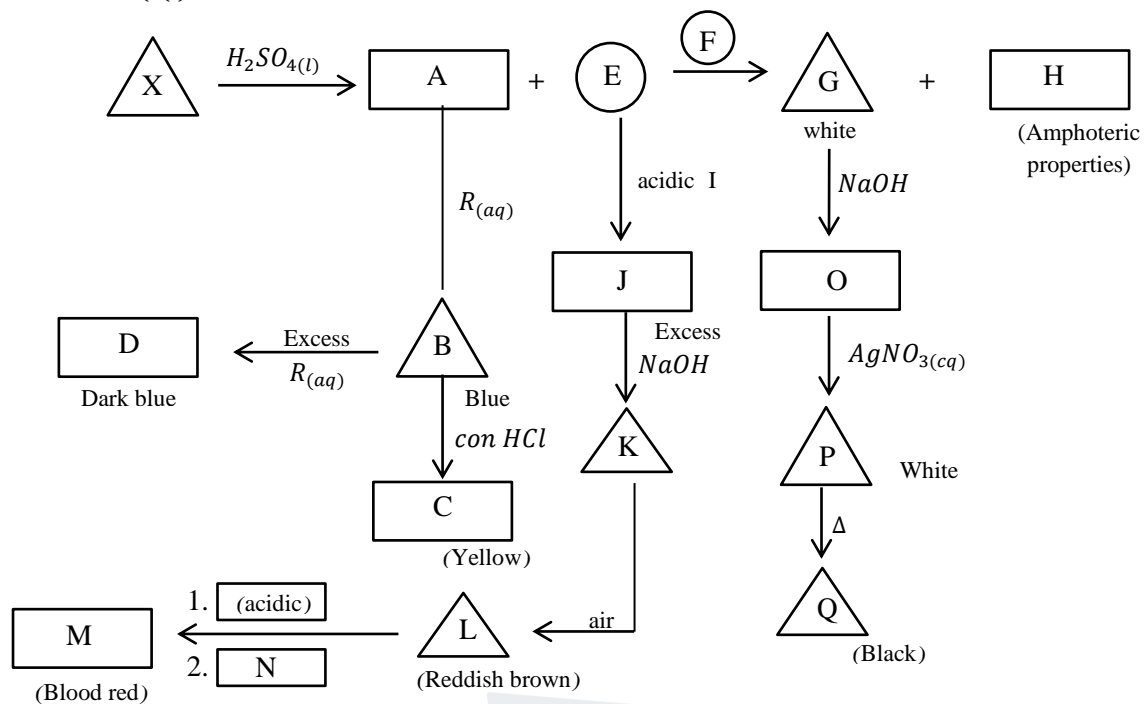
Metal / precipitate (Turbidity)

Solution / liquid

Gas
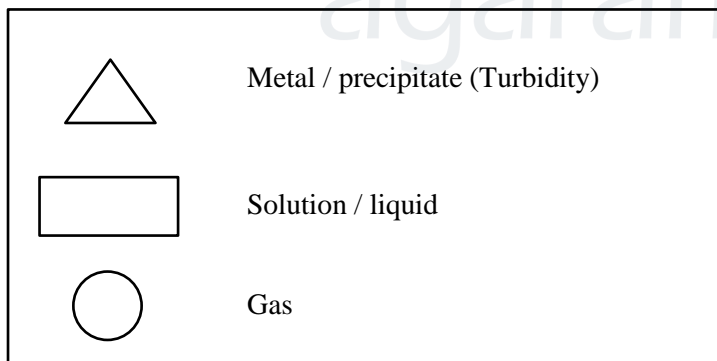
Note : $N + NaOH \rightarrow$ Gives $R_{(g)}$ as a product

(R – gives brown color with Nessler's reagent)

i) Identify of X .

ii) Give the structures of the compounds named from A – R.

iii) Give the balanced chemical equation / equations for the reaction / reactions of G with NaOH.

b) You are provided with a finely powdered sample containing Fe, Cu and Mn along with impurities. The following procedures were carried out to find the mass percentages of the metals in the sample.

Procedure I

4.5 g of the sample was dissolve in 500 cm^3 of dil H_2SO_4 and 25 cm^3 of this solution was mixed with excess KI. As the result white precipitates CuI and I$_2$ were obtained as the only products. I$_2$ formed during the reaction was used as starch indicator and titrated with 20cm^3 of 0.05moldm^{-3} Na$_2$S$_2$O$_3$

Procedure II

Another 25cm^3 portion was taken from the above 500cm^3 solution and titration with $0.02 moldm^{-3}$ acidic $KMnO_4$ Required volume is 15 cm^3

Procedure III

Oxidizing agent $K_2S_2O_8$ was added to the solution resulted from procedure II. The resultant was titrated with $0.2\ moldm^{-3}\ Fe^{2+}$ solution until the purple colour of the solution disappeared. The burette reading at the end of the titration was 40cm^3. Only the following reactions took place during this procedure.
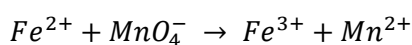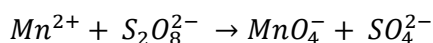
$$Mn^{2+} + S_2O_8^{2-} \rightarrow MnO_4^- + SO_4^{2-}$$
$$Fe^{2+} + MnO_4^- \rightarrow Fe^{3+} + Mn^{2+}$$
$$(Mn - 55, Fe - 56, Cu - 63.5)$$

I) Give the balanced chemical equations for the above procedure

II) Find the mass percentage of Fe, Cu and Mn in the sample.

10) a) I) Give the chemical formula of hydroxides formed by third period elements in their highest oxidation states and mention whether they are acidic or basic or amphoteric

II) A is a compound made up of non – metals that belongs to S, P groups. Consider the following reaction series and identify the chemical formula from A to L.
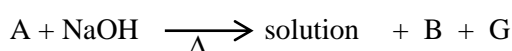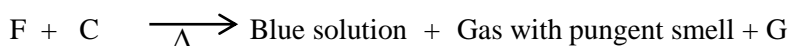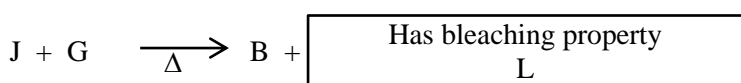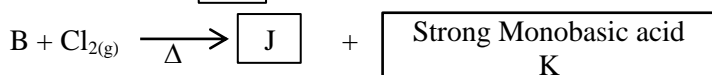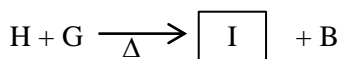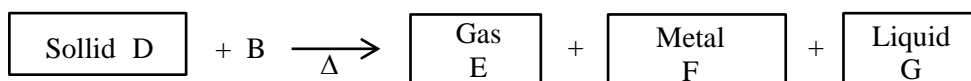
b) Pure gas P was kept in a container of volume $Y\,dm^3$ at 100K under the pressure of 8.314×10^5Pa then a catalyst was added and

$$4\,P_{(g)} \;\rightleftharpoons\; Q_{(g)} + 4\,R_{(g)} \qquad -(1)$$
$$2\,Q_{(g)} \;\rightleftharpoons\; S_{(g)} + 2\,T_{(g)} \qquad -(2)$$
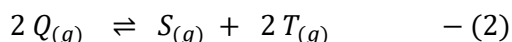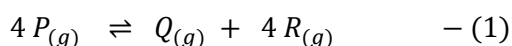
The above two equilibria were obtained at 100K. If degree of dissociation (α) of first and second equilibria are 0.5 and 0.25 respectively and KP of second equilibrium is 2×10^4Pa Then

(i) What is the partial pressure of S

(ii) Calculate K_p of equilibrium (i) at 100K

(iii) If $K_p = 3 \times 10^6$Pa for equilibrium (1) at 400K, then find the sign of the enthalpy change in forward reaction..

(iv) Explain the change that will happen when small amount of $S_{(g)}$ is added to the system at constant temperature.

(v) It small amount of $P_{(g)}$ is added to the system at constant temperature, complete the following graph. (Until 30s)