

FWC

Conducted by Field Work Centre, Thondaimanaru  
In Collaboration with Provincial Department of Education

Northern Province

Term Examination, June - 2019

Grade - 13 (2019)

Chemistry I

Time : 2 Hours

Part - I

- 1) The number of electron pairs in the sub orbital of the outer shell gaseous ground state  $\text{Co}^{2+}$  ion.  
1. 2                      2. 3                      3. 4                      4. 5                      5. 0
- 2) Which of the following quantum number / numbers related with the shape of atomic orbital in an atom.  
1.  $n$                                       2.  $l$  and  $m_l$                                       3.  $n$  and  $l$   
4.  $n$  and  $m_l$                                       5.  $m_l$  and  $m_s$
- 3) 
$$\begin{array}{ccccccc} & O & & & O & & \\ & || & & & // & & \\ H - C - CH_2 - C = C - C - O - C_2H_5 & & & & & & \\ & | & | & & & & \\ & Br & OCH_3 & & & & \end{array}$$
 The IUPAC name of the compound given below.  
1. ethyl 3-bromo-4-formyl-2-methoxybut-2-enoate.  
2. ethyl 3-bromo-2-methoxy-5-oxopent-2-enoate.  
3. 3-bromo-1-ethoxy-2-methoxy-4-formylbut-2-en-1-one.  
4. 3-bromo-5-ethoxy-4-methoxy-5-oxopent-3-enal.  
5. ethyl-3-bromo-4-formyl-2-methoxybut-2-enoate.
- 4) The correct descending order of the oxidation state of "S" in the molecules.  
1.  $\text{Na}_2\text{S} > \text{S}_2\text{Cl}_2 > \text{S} > \text{Na}_2\text{SO}_3 > \text{Na}_2\text{SO}_4$                       2.  $\text{Na}_2\text{SO}_4 > \text{Na}_2\text{SO}_3 > \text{Na}_2\text{S} > \text{S}_2\text{Cl}_2 > \text{S}$   
3.  $\text{S} > \text{S}_2\text{Cl}_2 > \text{Na}_2\text{S} > \text{Na}_2\text{SO}_3 > \text{Na}_2\text{SO}_4$                       4.  $\text{Na}_2\text{SO}_4 > \text{Na}_2\text{SO}_3 > \text{S}_2\text{Cl}_2 > \text{S} > \text{Na}_2\text{S}$   
5.  $\text{Na}_2\text{SO}_4 > \text{Na}_2\text{S} > \text{Na}_2\text{SO}_3 > \text{S}_2\text{Cl}_2 > \text{S}$
- 5) The stable resonance structures of  $\text{N}_2\text{O}_5$  molecule.  
1. 9                      2. 8                      3. 6                      4. 5                      5. 4
- 6) The molality of HCl in ( $\text{mol kg}^{-1}$ ) with the density  $1.365 \text{ g cm}^{-3}$  and 27 % by (W/W) mass percentage of HCl solution. (H=1 Cl = 35.5)  
1. 7.3                      2. 7.5                      3. 8.3                      4. 8.5                      5. 10
- 7) Which of the following statement is false?  
1. Among the group I hydroxides LiOH is thermally unstable.  
2. All the nitrates in group II are soluble.  
3. All the chlorides in group II are soluble in water.  
4. All the metal carbonates in group I are soluble in  $\text{H}_2\text{O}$ .  
5. The hydrides of N and P show weak basic nature.

8) A solution saturated with AgCl and AgBr at 25 °C temperature is prepared by dissolving AgBr and AgCl in water. Which of the following is false. (At 25 °C  $K_{sp}(AgCl) = 10^{-10} \text{ mol}^2 \text{ dm}^{-6}$   $K_{sp}(AgBr) = 10^{-12} \text{ mol}^2 \text{ dm}^{-6}$ ).

1.  $[Ag_{(aq)}^+] = [Cl_{(aq)}^-] + [Br_{(aq)}^-]$     2.  $[Cl_{(aq)}^-] = 100[Br_{(aq)}^-]$     3.  $100 [Cl_{(aq)}^-] = [Br_{(aq)}^-]$   
 4.  $\frac{K_{sp}(AgCl)}{[Cl_{(aq)}^-]} = \frac{K_{sp}(AgBr)}{[Br_{(aq)}^-]}$     5.  $\frac{K_{sp}(AgCl)}{[Ag_{(aq)}^+]} + \frac{K_{sp}(AgBr)}{[Ag_{(aq)}^+]} = [Cl_{(aq)}^-] + [Br_{(aq)}^-]$

9) Which of the following has a positive value for its electron gaining energy.

1. Li                      2. Be                      3. B                      4. O                      5. K

10) Which of the following is false regarding the 3d – elements.

1. V has the highest melting point than others.  
 2. Their electronegativity values are higher than that of corresponding S – block elements.  
 3. Mn and Cu are lower melting point and boiling point next to Zn.  
 4. Their oxides are used as catalysts.  
 5.  $[Cr(NH_3)_6]^{3+}_{(aq)}$  is yellow in colour.

11) Which of the following relationship is correct with the angle of O – S – O in sulphur species.

1.  $SO_3^{2-} < SO_4^{2-} < SO_2 < SO_3$                       2.  $SO_4^{2-} < SO_3^{2-} < SO_2 < SO_3$   
 3.  $SO_3^{2-} < SO_4^{2-} < SO_3 < SO_2$                       4.  $SO_4^{2-} < SO_3^{2-} < SO_3 < SO_2$   
 5.  $SO_3 < SO_2 < SO_4^{2-} < SO_3^{2-}$

12) In a closed rigid container the elementary reaction  $2A_{(g)} \rightarrow B_{(g)}$  takes place at constant temperature. Initial pressure of the container  $P_0$  and its rate of reaction is 25% in its initial value when pressure of A is  $P_A$ . The correct value of  $\frac{P_A}{P_0}$ .

1.  $\frac{P_A}{P_0} = \frac{1}{\sqrt{2}}$     2.  $\frac{P_A}{P_0} = 1/2$     3.  $\frac{P_A}{P_0} = \sqrt{2}$     4.  $\frac{P_A}{P_0} = 2$     5.  $\frac{P_A}{P_0} = 4$

13) Which of the following statements is false regarding half life period of a reaction.

1. The time taken to its concentration of reactant change as half.  
 2. Always it is not a constant.  
 3. Always it is independent in temperature.  
 4. The half life time of a 1<sup>st</sup> order reaction is constant.  
 5. Always it depends its order of the reaction.

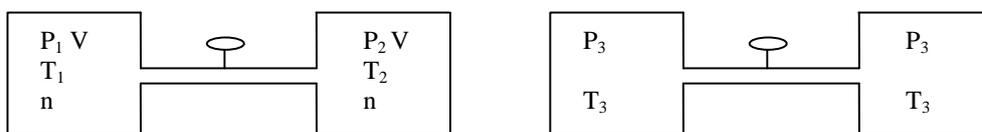
14) The thermal decomposition Nitrogen products of  $NH_4NO_{2(s)}$ ,  $(NH_4)_2Cr_2O_{7(s)}$  and  $NH_4NO_{3(s)}$  are respectively.

1.  $N_2, N_2, N_2$     2.  $N_2O, N_2O, N_2$     3.  $N_2, N_2O, N_2$     4.  $N_2, N_2, N_2O$     5.  $NO, N_2O, N_2O$

15) A buffer solution is prepared by mixing weak acid together with strong base. The correct ratio of concentration between acid and salt when the buffer solution prepared with  $pH = 6$ , is ( $K_a = 10^{-6} \text{ mol dm}^{-3}$ )

1. 5 : 4                      2. 4 : 5                      3. 1 : 2                      4. 2 : 1                      5. 1 : 1

- 16) The figure given below contains Ideal gas system A and B combined when open the tap. Which of the following statement is false?



A

B

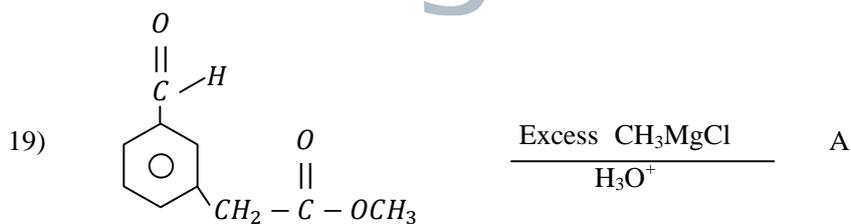
1.  $\frac{P_1 V}{T_1} + \frac{P_2 V}{T_2} = \frac{P_3 2V}{T_3}$
2.  $\frac{P_3 T_1}{P_1} + \frac{P_3 T_2}{P_2} = 2T_3$
3.  $\frac{P_1}{T_1} + \frac{P_2}{T_2} = \frac{P_3}{T_3}$
4.  $\frac{T_3 P_1}{T_1} + \frac{T_3 P_2}{T_2} = 2 P_3$
5.  $\frac{P_1 V}{R T_1} + \frac{P_2 V}{R T_2} = 2 n$

- 17) Which of the following statements is false regarding phenol.

1. It shows weak acidic property.
2. It doesn't form Ester with  $C_2 H_5 OH$  in the presence of acid.
3. It evolves  $CO_2$  gas when reacted with  $Na_2 CO_3$  and  $NaHCO_3$ .
4. It dissolve in  $NaOH$  solution.
5. It change pink colour with light in air.

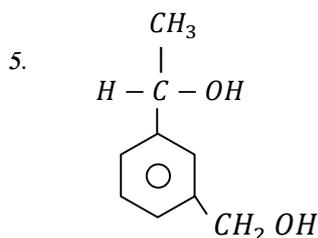
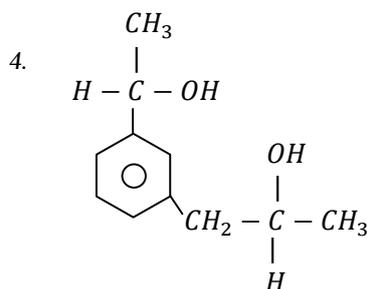
- 18) Which of the following statement is false regarding to calculate the order of reaction by experimentally.

1. The order of the reaction  $Mg$  with  $HCl$  is calculated by the time taken when constant volume of  $H_{2(g)}$ .
2. The order of the reaction  $Na_2 S_2 O_3$  with  $HCl$  is calculated by the time taken to unknown the centre mark.
3. There is no indicator used in  $Fe^{3+}/I^-$  experiment.
4. The order of the reaction of  $Fe^{3+}/I^-$  experiment is calculated by the time taken for colour change.
5. When the total volume of the reactants are maintain constant as the concentration of compounds constant except experimental reactant.



A major product of A is,

- 1.
- 2.
- 3.



20) Consider the reaction  $A_{(s)} + A O_{2(g)} \rightarrow 2A O_{(g)}$   $\Delta G^\circ$  values at different temperature is,

T / K	$\Delta G^\circ / kJ \text{ mol}^{-1}$
500	- 150
1000	- 200

The standard entropy change for the above reaction is,

1.  $0.1 \text{ J mol}^{-1} \text{ K}^{-1}$     2.  $- 100 \text{ J mol}^{-1} \text{ K}^{-1}$     3.  $100 \text{ J mol}^{-1} \text{ K}^{-1}$     4.  $350 \text{ J mol}^{-1} \text{ K}^{-1}$     5.  $- 350 \text{ J mol}^{-1} \text{ K}^{-1}$

21) Which of the following statement is correct?

- In Hydrogen atom  $n = 1 \leftarrow n = 7$  electron transfer has the highest energy.
- Longest wavelength radiation present in Lyman series in a H spectrum.
- In H spectrum Lowest energy radiation present in Lyman series.
- In H spectrum shortest wavelength radiation present in Paschen series.
- In H spectrum wavelength range in visible region is  $200 - 500 \text{ nm}$ .

22) 3.56g, of  $KIO_3$  completely dissolved in water and the excess of KI was added. The liberated  $I_2$  was titrated with  $0.05 \text{ mol dm}^{-3} \text{ Na}_2\text{S}_2\text{O}_3$  solution. The required volume of  $\text{Na}_2\text{S}_2\text{O}_3$  was  $20 \text{ ml}$ . The mass percentage of  $KIO_3$  in the sample was (  $O = 16, K = 39, I = 127$  )

1. 3 %    2. 1 %    3. 0.1 %    4. 0.3 %    5. 0.6 %

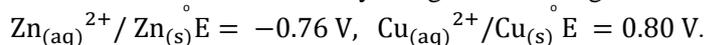
23) Which of the following process evolved heat for environment.

- Dissolve  $\text{NaCl}_{(s)}$  in water.
- Dissolve  $\text{NH}_4\text{Cl}_{(s)}$  in water.
- Mixed together con.  $\text{H}_2\text{SO}_4$  with water.
- Keeping naphthalene balls in air.
- Keeping open  $\text{Br}_2$  liquid bottle in air.

24) Which of the following statement is not suitable for both gases  $\text{SO}_2$  and  $\text{H}_2\text{S}$ .

- Act as an oxidizing agent
- Act as an reducing agent
- Both are acidic gases
- Influence for acid rain.
- Change the colour of wet blue litmus paper.

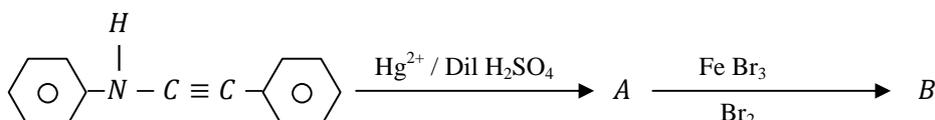
25) A standard cell is constructed by using the following electrodes.



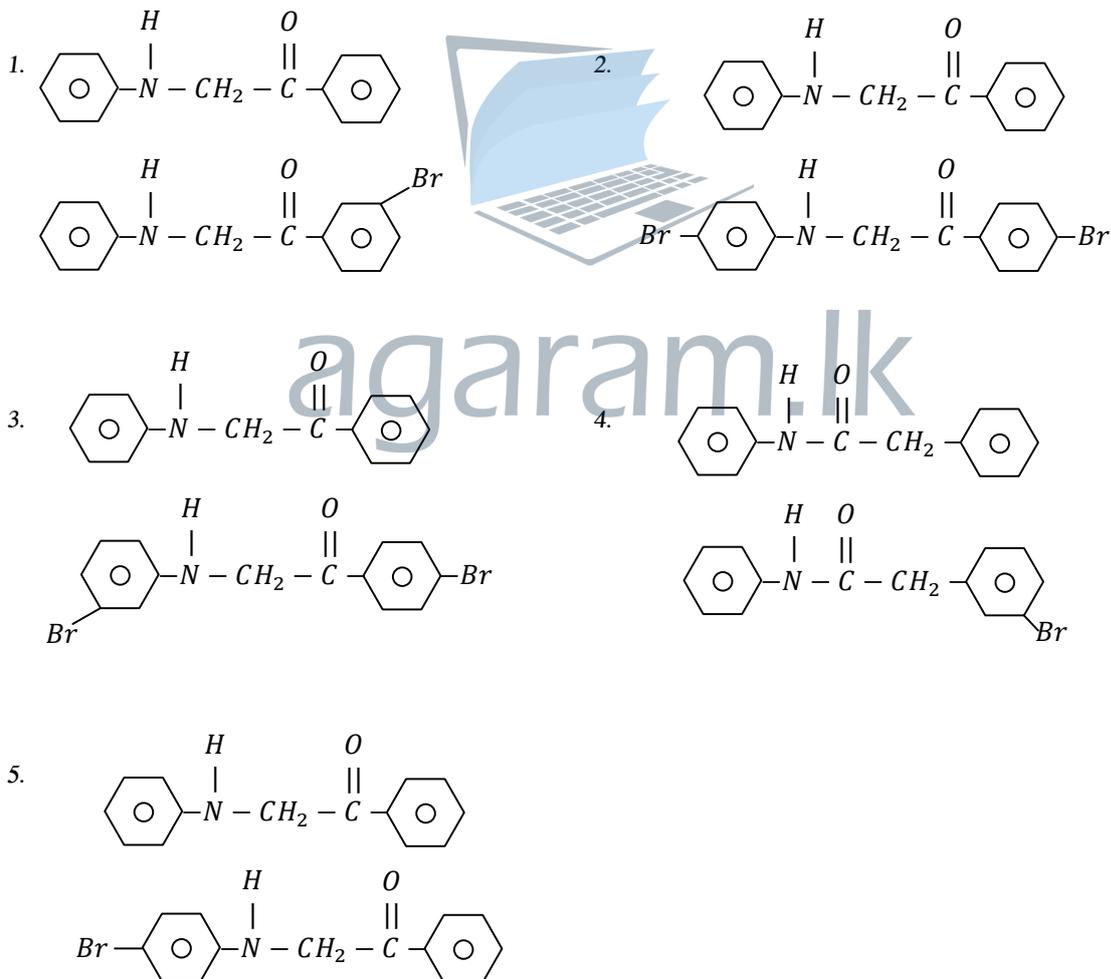
Which of the statement is true regarding the electro chemical cell.

1. The electrode Zn act as anode it oxidises electron transferred to Cu to Zn.
2. The electrode Cu act as anode, Cu oxidizes electron transferred to Cu to Zn.
3. The cations moving to anode portion by using salt bridge.
4. The  $\text{Zn}^{2+}$  ions move to cathode portion by using salt bridge.
5. The anions move to anode portion by using the salt bridge.

26) Consider the following reactions scheme.



In the above reaction scheme, the possible structure of A and B are,



27) Which of the following is false regarding with Acid - Base titration.

1. Equivalence point is the midpoint of the rapid pH range.
2. pH of equivalence point is related with type of titration.
3. At equivalence point the titration flask don't have excess acid or base.
4. Equivalence point is lower than endpoint.
5. Always the endpoint of the solution shows acidic property.

28) Which of the following statement is false regarding polymer.

1. Teflon is thermally stable but it is a thermoplastic polymer.
2. Urea – formaldehyde is a thermosetting polymer.
3. Every repeated unit of natural rubber contains a double bond.
4. Epanite is formed when 25 – 30 % of sulphur added to natural rubber.
5. Natural rubber is a condensation polymer.

29) Which of the following statement is false.

1. For an equilibrium closed system and constant temperature are compulsory.
2. At equilibrium the rate of forward is equal to the rate of backward.
3. At equilibrium the rate of reactants formed may be equal with rate of products formed.
4. At equilibrium, the equilibrium constant is equal to the ratio between the rate constant of forward and that of backward.
5. The equilibrium rate constant of forward reaction is equal that of backward reaction.

30) Which of the following is false regarding electrolysis.

1. Product changes with the nature of electrolyte.
2. Product changes with the concentration of electrolyte.
3. Product changes with electrodes.
4. There is no change in product when temperature changes.
5. Product changes with the surface area of electrode.

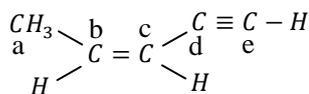
❖ For each of the question 31 to 40 one or more response out of four responses (a), (b), (c) and (d) given is / are correct. Select the correct responses / responses. In accordance with the instruction given on your answer sheet mark.

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

31) Which of the following statement / s is / are correct regarding catalyst.

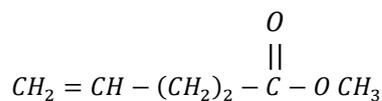
- (a) The catalyst does not change the overall order of reaction at anytime.
- (b) The catalyst increases the amount of products.
- (c) The catalyst changes the activation energy of a particular reaction.
- (d) The catalyst changes the mechanism of the reaction to take place through the smallest step.

32) Which of the following statement/s is / are true regarding the molecule given below.



- (a) All the C atoms are in same plane.
- (b) One  $\sigma$  bond and  $2\pi$  bonds are between  $\text{C}_d$  and  $\text{C}_e$ .
- (c) The bond angle of  $\text{C}_a - \text{C}_b - \text{H}$  is nearly equal to  $109^\circ$ .
- (d) The bond length of  $\text{C}_b - \text{C}_c$  is small than that of  $\text{C}_d - \text{C}_e$ .

33) Which of the following statement/s is / are true regarding the molecule given below.



- (a) It decolourized  $\text{Br}_2 / \text{CCl}_4$
- (b) It undergoes hydrolysis with  $\text{NaOH}_{(\text{aq})}$  in basic medium.
- (c) It reacted with  $\text{HBr}$  and don't give optical compound.
- (d) It undergoes reduction, treated with  $\text{NaBH}_4$ .

34) Which of the following statement is true for 2 - Butene.

- (a) It shows Geometrical isomerism.
- (b) It shows optical isomerism.
- (c) The product shows optical activity treated with  $\text{Ni} / \text{H}_2$
- (d) The product shows optical activity treated with  $\text{HCl}$ .

35) Which of the following is / are false regarding nitric acid.

- (a) Pure Nitric acid is a colourless liquid.
- (b) Nitric acid dissociates by light and liberated  $\text{NO}_2$ .
- (c) Nitric acid can't act as a base.
- (d) Nitric acid prepared by contact process.

36) Which of the following statement/s is / are true for a trimolecular elementary reaction in the gaseous phase.

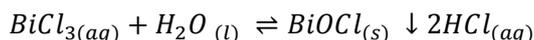
- (a) Rate of reaction doesn't depend the highest concentration reactant when comparing the reactants are 1000 times of other.
- (b) When a reaction the concentration change of reactant is negligible then it doesn't depend its rate of reaction.
- (c) The order of any reactant take zero.
- (d) The rate of reaction depends the slowest step.

37) Which of the following is correct regarding the production of  $\text{NaOH}$ .

- (a) Membrane cell is allowed to displace  $\text{Cl}^-$  ions from anode to cathode.
- (b) Membrane cell resists to displace  $\text{OH}^-$  ions.
- (c)  $\text{NaOH}$  solution is partially vapourized and then allowed to cool.
- (d) Sea water is used as raw material.

- 38) Which of the following is true for a spontaneous reaction at temperature T.
- Gibb's energy must be a positive value.
  - Reaction must be a negative value of enthalpy change.
  - If the entropy change is negative then reaction enthalpy is negative value.
  - If the entropy change is positive then reaction enthalpy take negative or positive value.

- 39) Which of the following statement/s is/are true regarding the equilibrium given below.



- It exists  $\text{BiCl}_{3(aq)}$ ,  $\text{H}_2\text{O}_{(l)}$ ,  $\text{BiOCl}_{(s)}$ ,  $\text{HCl}_{(aq)}$  all to observe the equilibrium.
  - There are four species in the equilibrium constant formula.
  - If  $\text{BiOCl}_{(s)}$  is added, the equilibrium move to left side.
  - If  $\text{H}_2\text{O}_{(l)}$  is added the equilibrium move to right side.
- 40) Which of the following statement/s is/are false.
- Natural abundance of Ti is Rutile and Ilmanite is Sri Lanka.
  - Cinnamon oil is extracted from its leaves by fractional distillation method.
  - Cannot calculate the impurity of water using by dissolved  $\text{O}_2$  in water and COD.
  - Using Winkler's method, calculated the amount of dissolved  $\text{O}_2$  in water.

❖ Instructions for questions 41 to 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)	$\text{NaCl}$ is more thermal stability than $\text{NaBr}$	The radius of anions increases, polarizability increases.
42)	Reaction speed of nucleophilic addition of aldehyde is higher than that of similar ketones.	During the repulsion of carbonyl carbon alkyl group in Ketone, they change smallest positive.

43)	At constant temperature $H_{2(g)} + I_{2(s)} \rightleftharpoons 2 HI_{(g)}$ reduce the pressure of equilibrium mixture, equilibrium moves Right hand side.	At constant temperature when the pressure of equilibrium gases reduced, the reaction takes place in the number of molecules decreasing side.
44)	ZnS and MnS are dissolved in dil HCl	In acidic medium $Zn^{2+}$ and $Mn^{2+}$ are not precipitated in the presence of $H_2S$
45)	Boiling point of $CH_3CH_2CH_2CH_3$ , $CH_3 - \overset{O}{\parallel} C - CH_3$ are higher than that of $CH_3CH_2CH_2OH$ .	There is a H bond present in $CH_3CH_2CH_2CH_2OH$ and that is not in $CH_3CH_2CH_2CH_3$ , $CH_3 - \overset{O}{\parallel} C - CH_3$
46)	If the water evaporates in a closed system the entropy of surrounding is increases.	In a closed system absorb the heat, that increase the thermal motion of surrounding.
47)	In soap production esters of fatty acids are hydrolysed by NaOH / KOH in basic medium.	Basic hydrolysis of Esters give salt of Na or K of carboxylic acid and alcohol.
48)	Stability of phenol related with phenate ion is lower than alcohol related alcoxide ion.	There is reasonance in alcoxide but not in phenate ion.
49)	At constant temperature the dissociation of weak acid increase, their concentration decreases.	At constant temperature dissociation of weak acid directly proportion to its concentration.
50)	The Global warming is reduces by increasing to plant green trees.	Amount of $CO_2$ level is controlled by increasing the green trees.



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

Grade - 13 (2019)

Chemistry II A

Time :- Three hours 10 minute

**Part II A**  
**Structured Essay**

1) (A) Arrange the following in increasing order of the property indicated within the Parenthesis.

(i) *C, N, Cl, Ar* (First ionization Energy)

.....

(ii) *Li, F, Al, Ca* (Atomic radius)

.....

(iii) *P, Mg, O, Cl* (First electron affinity energy)

.....

(iv) *SO<sub>2</sub>, SO<sub>3</sub>, H<sub>2</sub>S, H<sub>2</sub>SO<sub>4</sub>* (Electro negativity of sulfur)

.....

(v) *NF<sub>3</sub>, NH<sub>3</sub>, CCl<sub>4</sub>, AlCl<sub>3</sub>* (Bond angle)

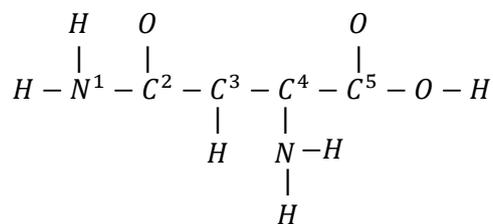
.....

(vi) *NaCl, KCl, RbCl, LiCl* (Melting point)

.....

(3.0 Marks)

(B) The following questions (i) to (v) are based on the amino acid. The Skelton of which is given below



(i) Draw the most acceptable Lewis structure for the above amino acid.

.....  
.....  
.....  
.....  
.....

- (ii) Draw the resonance structure for the given amino acid molecule and comment on the stability of this resonance structure.

.....

.....

.....

.....

.....

.....

- (iii) Based on the Lewis structure drawn in part (i) state, the following regarding the N<sup>1</sup>, C<sup>2</sup>, C<sup>3</sup> and C<sup>4</sup> atoms given in the table.

- VSEPR pairs around atom.
- Electron pair geometry around atom.
- Hybridization of the atom.
- Shape around the atom.

		N <sup>1</sup>	C <sup>2</sup>	C <sup>3</sup>	C <sup>4</sup>
(a)	VSEPR Paris				
(b)	Electron Pair geometry				
(c)	Hybridization				
(d)	Shape				

- (iv) Identify the atomic / hybrid orbitals involved in the formation of the following  $\sigma$  bonds in the Lewis structure drawn in Part (i)

- (a) N<sup>1</sup> – C<sup>2</sup>      N<sup>1</sup> ..... C<sup>2</sup> .....
- (b) C<sup>2</sup> – C<sup>3</sup>      C<sup>2</sup> ..... C<sup>3</sup> .....
- (c) C<sup>4</sup> – C<sup>5</sup>      C<sup>4</sup> ..... C<sup>5</sup> .....

- (v) Sketch the shape of the Lewis structure of amino acid drawn in Part (i) indicating approximate values for the bond angles.

.....

.....

.....

.....

(5.0 Marks)

- (C) With respect to each of the species given in the table below, Identify the types of interactions present in each case.

Species	Primaryinteraction	Secondaryinteraction
CaCl <sub>2(s)</sub>		
H <sub>2</sub> O <sub>(l)</sub>		
Graphite <sub>(s)</sub>		
Ar <sub>(g)</sub>		
K <sub>(s)</sub>		

(2.0 Marks)

2) (A) Q is an element in the P block of Periodic table with atomic number less than 20. Its first eight successive ionization energies are 1600, 2260, 3390, 4540, 6990, 8490, 27100, 31700  $\text{kJ mol}^{-1}$  respectively. Q exists in four allotropic forms and two of them are crystalline structures.

(i) Identify the element Q.

.....

(ii) Name the four allotropes of Q.

.....

.....

(iii) When Q is subjected to complete combustion in the air a colourless gas  $X_1$  forms. When the colorless identify gas  $X_1$  reacts with air under certain conditions, another colourless gas  $X_2$  was forms. Identity  $X_1$  and  $X_2$ .

$X_1$  .....

$X_2$  .....

(iv) Draw the Lewis structures for  $X_1$  and  $X_2$ .

.....

.....

.....

(v)  $X_1$  acts as oxidizing and reducing agents. Give one example to each statement mentioned above. (Give balanced chemical equations.)

.....

.....

.....

.....

(B) The test tubes labelled A to E contain solution  $\text{Pb}(\text{NO}_3)_2$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{CuSO}_3$ ,  $\text{FeCl}_3$ ,  $\text{K}_2\text{CrO}_4$ . Each test tubes contains one solution only, but identify of the solution is unknown.  $\text{BaCl}_2$  solution and diluted ammonia were added to each test tube separating and the respective observation are tabulated below.

Test tube	With $\text{BaCl}_2$ (aq)	With Diluted Ammonia solution
A.	A white precipitate insoluble in cold water, but soluble in hot condition.	A white precipitate.
B.	A white precipitate insoluble in dilute $\text{HNO}_3$ .	A clear solution.
C.	A white precipitate soluble in diluted $\text{HCl}$	When excess ammonia is added. deep blue coloured solution.
D.	A clear solution	Yellowish brown precipitate
E.	Yellow precipitate	No change was observed.

(i) Identify the solutions A to E.

A ..... B ..... C .....  
D ..... E .....

(ii) Write balanced chemical equations for all the reactions. Which give in precipitates.  
(Precipitated product must be indicated with the down ward arrow (↓))

(iii) Write the balanced chemical equation for the reaction involved in dissolution of precipitated product with diluted acid.

(iv) Write the molecular formula of the compound or complex ion which forms a deep blue coloured solution, on addition of excess ammonia.

(5.0 Marks)

3) (A) Write down the ideal gas equation and define all the terms in the equation given by you.

.....  
.....  
.....  
.....

(B) O<sub>2</sub> gas was produced in the laboratory by heating solid KMnO<sub>4</sub>, and collected by the downward displacement of water at 27 °C. The pressure and volume of the product O<sub>2</sub> gas at 27 °C was 1 x 10<sup>5</sup> Pa and 420 cm<sup>3</sup> respectively. Then that O<sub>2</sub> gas was passed into a 300 cm<sup>3</sup> vessel containing He gas at 27 °C and at pressure 1.2 x 10<sup>5</sup> Pa. (K = 39, Mn = 55, O = 16)

(i) Write the balanced chemical equation for the reaction that produce O<sub>2</sub> gas from KMnO<sub>4</sub>.

.....  
.....  
.....

(ii) Calculate the number of moles of O<sub>2</sub> gas, evolved during the above reaction.

.....  
.....  
.....  
.....  
.....  
.....

(iii) Calculate the mass of KMnO<sub>4(s)</sub> reacted during the reaction.

.....  
.....  
.....  
.....

(iv) After mixing the two gasses ( $O_2$  and He). What is the total pressure of the mixture at  $27^\circ C$ .

.....  
.....  
.....  
.....  
.....

(v) Calculate the mole fraction of  $O_2$  gas in the mixture at  $27^\circ C$ .

.....  
.....

(6.0 Marks)

(C) (i) For an ideal solution write the definition for Raoult's Law.

(ii) A mixture of Liquid A and B behave ideally. Saturated vapour Pressure of liquids pure A and B are  $P_A^O$  and  $P_B^O$  respectively at Temperature T K. If the mole fractions of A and B are  $X_A$  and  $X_B$  respectively in the liquid phase, show that the mole fraction of A in vapour phase

$$\frac{P_A^O X_A}{P_A^O X_A + P_B^O X_B}$$

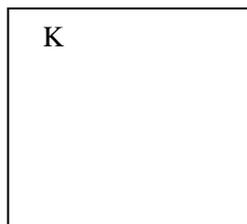
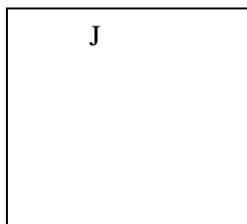
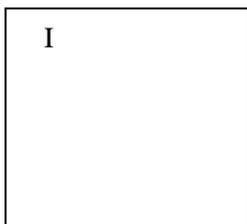
(iii) Saturated vapour pressure of A and B are  $0.5 \times 10^4$  Pa and  $0.3 \times 10^4$  Pa at  $27^\circ C$ . Both A and B behave ideally at this temperature. At this equilibrium mole fraction of A in liquid phase is 0.4. Calculate the total pressure and mole fraction of A in vapour phase.

(4.0 Marks)

4) (A) The primary amines A, B, C and D are structural isomers of each other having the molecular formula  $C_5H_{13}N$ . A, B and C shows optical isomerism. A, B, C and D react with  $NaNO_2 / HCl$ , the products E, F, G and H are formed respectively. E, F and G on treated with acidified  $K_2Cr_2O_7$ . E and F give ketones I and J respectively. G gives carboxylic acid K, as product. But H does not react with acidified  $K_2Cr_2O_7$  under normal conditions.

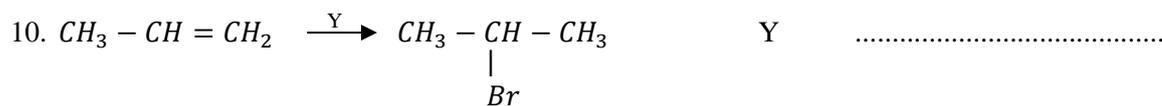
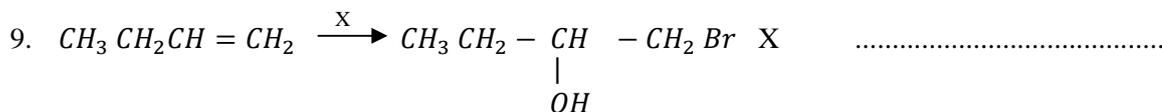
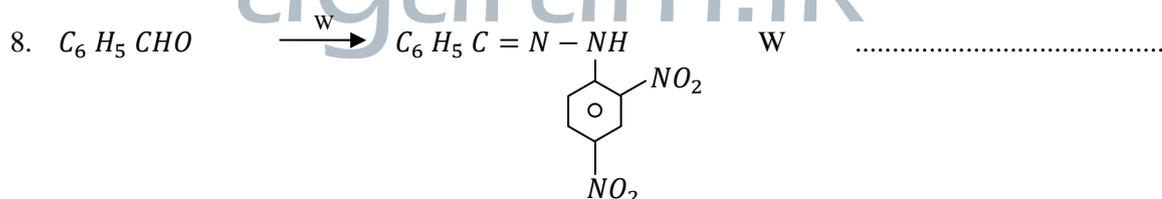
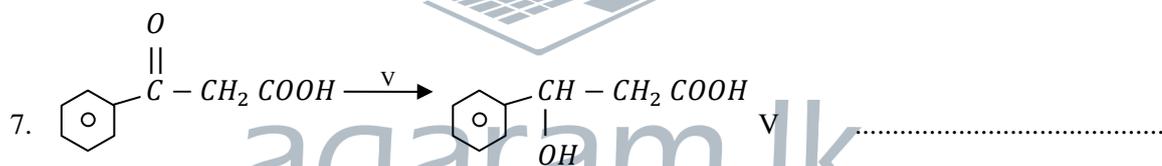
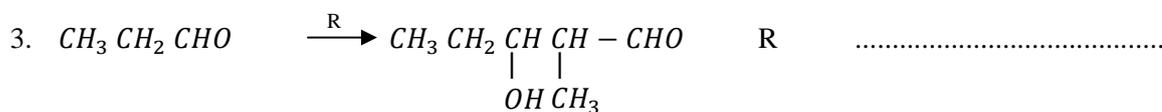
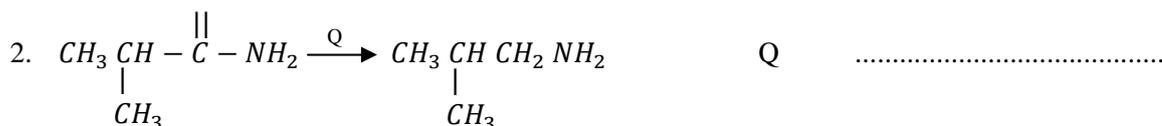
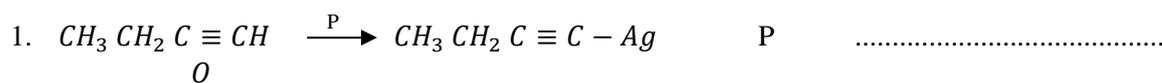
Draw the structure of A, B, C, D, E, F, G, H, I, J and K in the boxes given below.

A	B	C	D
E	F	G	H



(5.0 Marks)

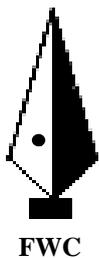
(B) Write the reagent (s) / catalyst (s) P, Q, R, S, T, U, V, W, X and Y for the following reactions.



(4.0 Marks)

(C) Write the mechanism for the reaction (10) above.

(0.5 Marks)



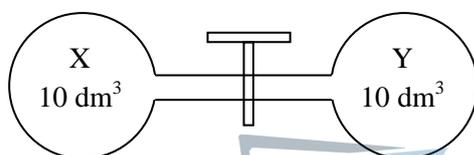
Conducted by Field Work Centre, Thondaimanaru  
In Collaboration with Provincial Department of Education  
Northern Province  
Term Examination, June - 2019

Grade – 13 (2019)

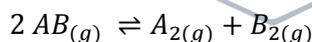
Chemistry II B

Part II B  
Essay Questions

- 5) (A) Two rigid vessels X and Y each of  $10 \text{ dm}^3$  volume were connected by a small tube, volume of that tube was neglected and tap was placed with a small tube, which was connected with two vessels.



Initially the tap was closed at 300 K. Vessel X contains 1.4 mol of  $\text{AB}_{(g)}$  and Y is empty. When the system was increased to 350 K  $\text{AB}_{(g)}$  is dissociated into  $\text{A}_{2(g)}$  and  $\text{B}_{2(g)}$  according to the equilibrium reaction given below,



When the system has reached equilibrium at 350 K the amount of  $\text{B}_{2(g)}$  is 0.2 mol. After that the tap was opened and the system was allowed to reach second equilibrium at the same temperature 350 K and amount of  $\text{B}_{2(g)}$  is b mol.

- Write down the equation  $K_C$  for the above reaction with related to the concentration of products and reactant.
- Calculate the value for  $K_C$  at 350 K when the tap was closed?
- Calculate the value for 'b' in the second equilibrium when the tap was closed?
- Explain your answer (iii) above using the Le chateliers principle.
- The temperature of the system was increases to 500 K. Then the system was allowed to reached third equilibrium  $K_C$  of this equilibrium was  $9 \times 10^{-2}$ . Calculate the amount of  $\text{B}_{2(g)}$  at this equilibrium.
- Show that the equilibrium is endothermic or exothermic with reasons.

(70 Marks)

- (B) (i) Write the definition for bond dissociation energy.  
(ii) Using the given data below calculate the formation enthalpy of  $\text{PCl}_{5(g)}$  at 25 °C.

$$\text{Atomization of P}_{(s)} \Delta H^{\circ}_{\text{atm}} = 315 \text{ kJ mol}^{-1}$$

$$\text{Bond energy of P - Cl is} = 259 \text{ kJ mol}^{-1}$$

$$\text{Bond dissociation energy of Cl}_{2(g)} (\Delta H^{\circ}_D) \text{ is} = 242 \text{ kJ mol}^{-1}$$

(C) Consider the following reaction to answer the questions.



The following data are given for  $\Delta H_f^\theta$  and  $S^\theta$  at 25 °C.

	$\Delta H_f^\theta$ kJ mol <sup>-1</sup>	$S^\theta$ J mol <sup>-1</sup> K <sup>-1</sup>
PCl <sub>5(g)</sub>	-	364.6
PCl <sub>3(g)</sub>	- 287.0	311.8
Cl <sub>2(g)</sub>	0	223.1

- Calculate  $\Delta H^\theta$  for the above reaction at 25 °C.
- Calculate  $\Delta S^\theta$  for the above reaction at 25 °C.
- Find out  $\Delta G^\theta$  for the above reaction at 25 °C.
- Predict whether the above reaction is spontaneous or non spontaneous

(40 Marks)

6) (A) 100.00 cm<sup>3</sup> of 0.20 mol dm<sup>-3</sup> weak acid CH<sub>3</sub>COOH solution was prepared by diluting distilled water from appropriate amount of pure weak acid CH<sub>3</sub>COOH and pH of the solution is 2.8 at 25 °C.

- Write the equation for the dissociation constant  $K_a$  for the above weak acid.
- Calculate the value for  $K_a$  at 25 °C.
- 25.0 cm<sup>3</sup> of a diluted solution of CH<sub>3</sub>COOH was titrated with 0.2 mol dm<sup>-3</sup> KOH solution and the resultant solution was obtained equilibrium at 25 °C. Calculate the pH of this solution at equivalent point. ( $K_w = 1 \times 10^{-14}$  mol<sup>2</sup> dm<sup>-6</sup> at 25 °C)
- The above titration mixture was diluted upto 100 cm<sup>3</sup> with distilled water, Calculate the pH of this solution at 25 °C.

(50 Marks)

(B) At 25 °C an aqueous solution of 0.05 mol dm<sup>-3</sup> AgNO<sub>3</sub> is slowly added into an aqueous solution which contains 0.02 mol dm<sup>-3</sup> NaCl and 0.02 mol dm<sup>-3</sup> NaI.

The solubility product of two silver halides are given below at 25 °C.

$$K_{sp} [AgCl] = 1 \times 10^{-10} \text{ mol}^2 \text{ dm}^{-3}$$

$$K_{sp} [AgI] = 1 \times 10^{-18} \text{ mol}^2 \text{ dm}^{-3}$$

- Deduce whether AgCl or AgI will be precipitated first.
- At the instant when the second silver halide just begins to precipitate, calculate the remaining concentration of the halide ion which was precipitated first.
- State the assumption that is essential to, carry out the above calculations.

(40 Marks)

(C) The following experiment was done by the student to find out the partition coefficient of I<sub>2</sub> between CHCl<sub>3</sub> and water.

20.00 cm<sup>3</sup> of 0.1 mol dm<sup>-3</sup> solution of I<sub>2</sub> in CHCl<sub>3</sub> layer was shaken well with 100.00 cm<sup>3</sup> of water. Then the system was allowed to attain equilibrium at 25 °C. Then 10.0 cm<sup>3</sup> of CHCl<sub>3</sub> layer was separated out and it was titrated with 0.06 mol dm<sup>-3</sup> Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> solution and starch is used as an indicator. At the end point volume of Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> is 25.00 cm<sup>3</sup>.

- Write the equation for the partition coefficient constant of I<sub>2</sub> between CHCl<sub>3</sub> and aqueous layers.
- Calculate the initial mole of I<sub>2</sub>?

- (iii) Calculate the concentration of  $I_2$  in the  $CHCl_3$  and aqueous layer.  
 (iv) Calculate the partition coefficient of  $I_2$  between  $CHCl_3$  and water layers at  $25^\circ C$ .

(50 Marks)

7) (A) You are provided with the following

- $1.0 \text{ mol dm}^{-3} \text{ Zn SO}_4 \text{ (aq)}$   
 $1.0 \text{ mol dm}^{-3} \text{ M SO}_4 \text{ (aq)}$ ,  $1.0 \text{ mol dm}^{-3} \text{ CuSO}_4 \text{ (aq)}$
- Zn, M and Cu metals Rods.
- Conducting wires and beakers.
- Permeable membrane
- Digital volt meter G.

$$E^\ominus \text{ Zn}^{2+} / \text{ Zn} = -0.76 \text{ V}, \quad E^\ominus \text{ M}^{2+} / \text{ M} = E_1,$$

$$E^\ominus \text{ Cu}^{2+} / \text{ Cu} = +0.34 \text{ V},$$

Electro potential value of  $E^\ominus \text{ M}^{2+} / \text{ M}$  is greater than  $E^\ominus \text{ Zn}^{2+} / \text{ Zn}$  and less than  $E^\ominus \text{ Cu}^{2+} / \text{ Cu}$ .

- (i) Draw the most acceptable diagram of electrochemical cells which were connected in series. One of the electrode was connected two time in this electrochemical series. [maximum four electrodes and two cells should be in this series]
- (ii) Calculate the reading of the digital volt meter G.
- (iii) Calculate the value of  $E_1$  at  $25^\circ C$ . (The electromotive force of cell 1 which contain  $\text{Zn}_{(s)}$  and  $\text{M}_{(s)}$  electrodes is  $0.53 \text{ V}$ .)
- (iv) Write the balance chemical reaction taking place at the anode and cathode in each cells.

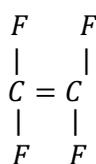
(50 Marks)

(B) "P" and "Q" are complex molecules with octahedral geometry and the metal ions have different oxidation number. The complex molecules P and Q have the following atomic composition  $\text{CoN}_6\text{H}_{18}\text{Cl}_2$ , and  $\text{CoH}_{12}\text{O}_6 \text{ Br}_3$ . In each complex molecules, particular number of specific ligands are coordinated to the metal ion. When aqueous solutions of P and Q are treated separately with  $\text{AgNO}_3$  solution. P gives white precipitate which is dissolved in diluted and concentrated ammonia solution, Q gives pale yellow precipitate which does not dissolve in diluted ammonia solution but dissolves in concentrated ammonia solution.

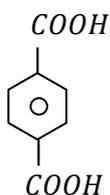
- (i) Identify the complex molecules P and Q by indicating the ligands coordinated with metal ion of cobalt.
- (ii) Write the IUPAC names of P and Q.
- (iii) Give IUPAC name of the two precipitates which are obtained from the above reaction.
- (iv) Write the electronic configuration of the cobalt ion in complex molecule P and Q.

(50 Marks)

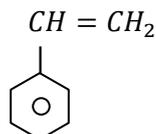
(C) Structure of some organic compounds are given below.



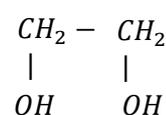
(A)



(B)



(C)



(D)

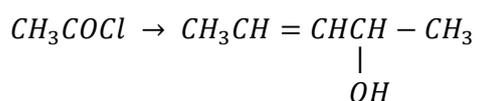
- (i) Which is / are the compound (s) that make condensation polymers.
- (ii) Which are the compounds that form addition polymers.
- (iii) Draw the structure of condensation polymer (mention repeat unit).
- (iv) Write the common name of the above condensation polymer.
- (v) Write the use of one of the additional polymers given by you.

(50 Marks)

### Part II C

8)

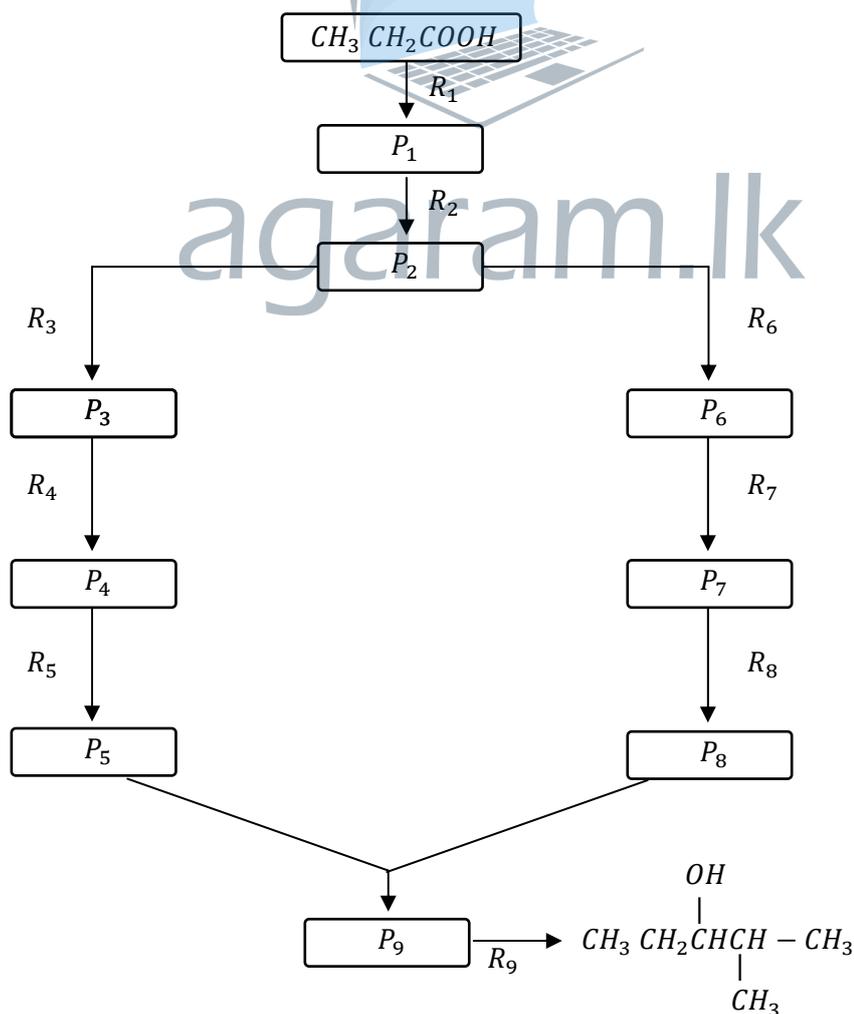
- (A) Show how the conversion given below could be carried out using only the chemicals in the list.



List of Reagents,  
 $CH_3MgCl$ , dilute  $NaOH$ ,  $LiAlH_4$ ,  $NH_3$ ,  $H_2O$ ,  
 $HCl$ , Pyridinium Chlorochromate (PCC),  $NaNO_2$

(60 Marks)

- (B) Identify  $P_1$  to  $P_9$  and  $R_1$  to  $R_9$  in order to complete the following reaction scheme.



(72 Marks)

- (C) (i) Provide a mechanism for ethylation of benzene in the presence of dry  $\text{AlCl}_3$ .  
(ii) Draw the possible resonance structure for the above mechanism.

(18 Marks)

- 9) (A) An aqueous solution 'X' consists of three cations and an anion. The following experiment were carried out two identify three cations and an anion in the solution X.

	Experiment	Observation
(i)	Solution X was acidified with dilute HCl.	Clear solution was formed.
(ii)	$\text{H}_2\text{S}$ gas was passed through the above solution.	Black precipitate "P <sub>1</sub> " was formed.
(iii)	Filtrate of the above (ii) was heated untile $\text{H}_2\text{S}$ gas was removed completely. Then $\text{NH}_4\text{Cl}$ and $\text{NH}_4\text{OH}$ were added.	White precipitate "P <sub>2</sub> " was formed.
(iv)	$\text{H}_2\text{S}$ gas was passed through the filtrate which was obtained from (iii)	Clear solution was formed.
(v)	Filtrate of the above (iv) was heated untile the $\text{H}_2\text{S}$ gas was removed completely. The $\text{NH}_4\text{Cl}$ $\text{NH}_4\text{OH}$ and $(\text{NH}_4)_2 \text{CO}_3$ were added.	White colours precipitate "P <sub>3</sub> " was formed
(vi)	Al powder and NaOH solution were added to the small amount of the intial solution X, then evolved gas was tested with the filter paper which was dipped in Nessler's	Filter paper turns two brown colour

Following experiments were done to the precipitates P<sub>1</sub>, P<sub>2</sub> and P<sub>3</sub> to identify three cations in the solution X.

	Experiment	Observation
a)	dilute HCl was added slowly to the precipitate "P <sub>1</sub> " untile it dissolved completely. Then excess ammonia solution was added.	Light blue colours solution was formed. deep blue colours solution was formed.
b)	Charcoal block test was done to the precipitate P <sub>2</sub> .	blue colours residue was formed.
c)	Flame test was done to the precipitate P <sub>3</sub> .	brick red colour flame was formed.

- (i) Identify three cations and an anion in the solution X.  
(ii) Write the balanced chemical equations which involve the formation of precipitates P<sub>1</sub>, P<sub>2</sub> and P<sub>3</sub>  
(iii) Write the balanced chemical equation which involves the formation of deep blue colour solution in experiment (a).  
(iv) Write the balanced chemical equation which involves the liberation of gas in the experiments (vi).

(75 Marks)

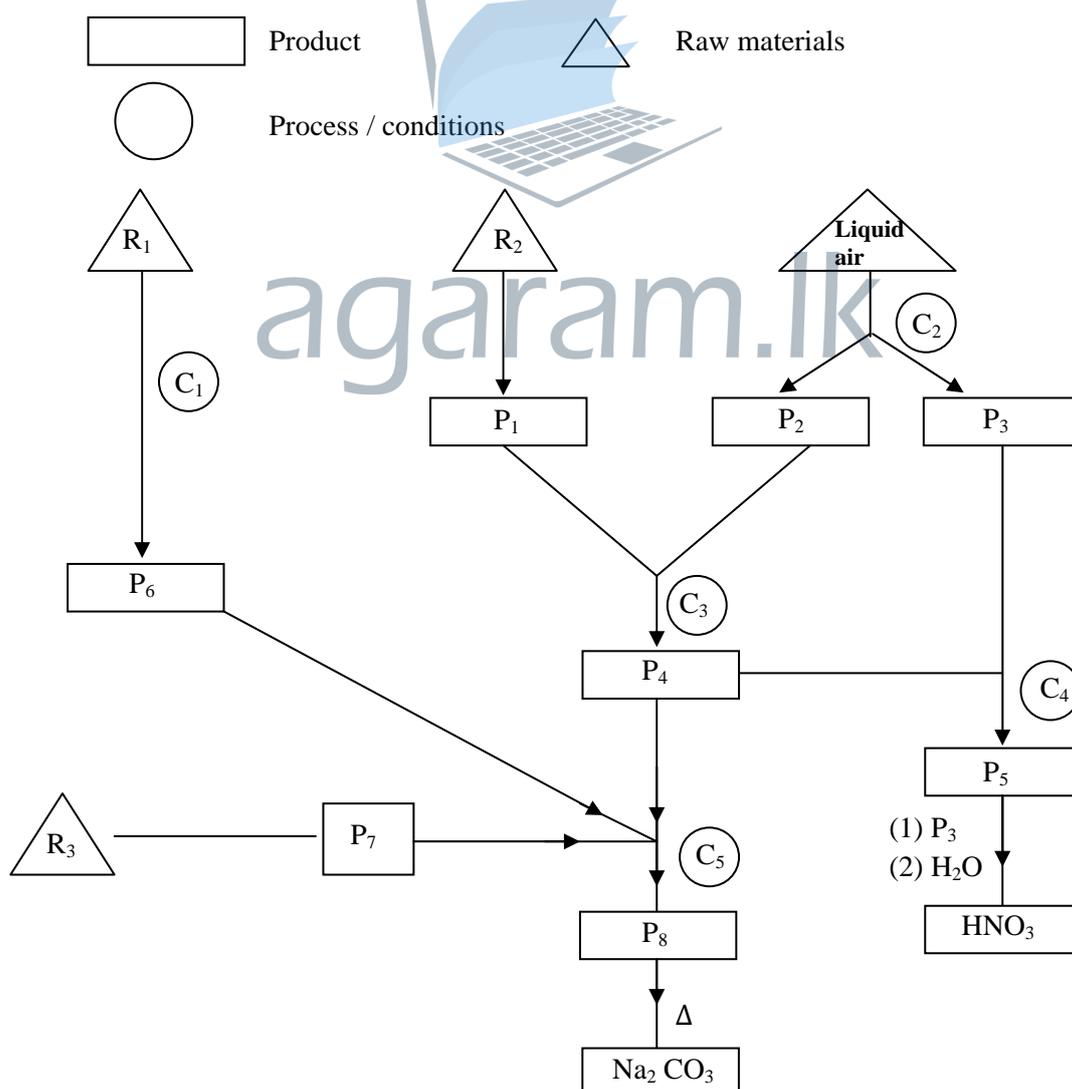
(B) L and M are successive elements in 3d series L and M form oxoanions which are tetrahedral shape and good oxidizing agents. L forms two oxoanions and oxidation number of L of these two oxoanions is same. The colour of the oxides of M in + iv oxidation state is brown.

- Give the name of the 3d elements L and M.
- Write the electronic configuration of L.
- Draw the Lewis structures for the above two oxoanions of L and M.
- Give the chemical formula of the oxides of M in its common oxidation states, and indicate whether each of the oxides acidic, basic and amphoteric.
- M has the lowest melting point and boiling point among the 3d transition elements, explain the reason for that.
- Give the colours change when  $H_2S$  gas was passed through the oxoanions of M in acidic medium.

(75 Marks)

10) (A) The flow chart based on three manufacturing process of chemical Industries.

The following symbols are used to represent raw materials, process / conditions and products.



- (i) Identify three raw materials  $R_1$ ,  $R_2$  and  $R_3$ .
- (ii) Identify the process or conditions  $C_1$ ,  $C_2$ ,  $C_3$ ,  $C_4$  and  $C_5$
- (iii) Identify the products  $P_1$ ,  $P_2$ ,  $P_3$ ,  $P_4$ ,  $P_5$ ,  $P_6$ ,  $P_7$  and  $P_8$

(80 Marks)

(B) Effluent gases released by various industries, causes acid rain and global warming.

- (i) Name three gases that contribute to global warming.
- (ii) Name three gases that contribute to acid rain.
- (iii) Explain how the gases stated in (ii) contribute to acid rain and give balanced chemical equations for the contribution of acid rain.
- (iv) Identify one industry which contribute global warming and acid rain.
- (v) Give three environmental effects causes by acid rain.



agaram.lk