



FWC

G.C.E. A/L Examination November - 2015

Conducted by Field Work Centre, Thondaimanaru

In Collaboration with

Zonal Department of Education Jaffna.

Grade :- 13 (2016)

Chemistry - I

Time :- Two hours

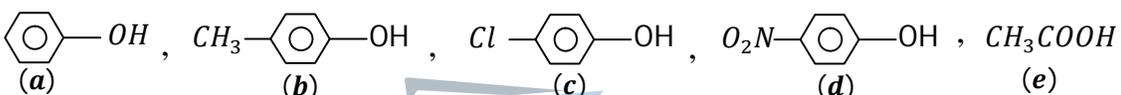
❖ Underline the correct answer.

01) The oxidation number and valency of the carbon atom in  $CH_2O$  are respectively.

- 1) 0, 4                      2) 0, 2                      3) +2, 4                      4) +4, 4                      5) +4, 2

02) Which period in the periodic table contains the highest percentage of non – metallic elements

- 1) 1                      2) 2                      3) 3                      4) 4                      5) 5

03)   $OH$  ,  $CH_3$ —— $OH$  ,  $Cl$ —— $OH$  ,  $O_2N$ —— $OH$  ,  $CH_3COOH$   
(a)                      (b)                      (c)                      (d)                      (e)

Which arrangement of compounds given above, gives the correct increasing order of acid strength?

- 1)  $e < d < c < a < b$                       2)  $b < a < c < d < e$                       3)  $d < c < a < b < e$   
4)  $e < b < a < c < d$                       5)  $c < d < a < b < e$

04) Which of the following will not colour the  $CCl_4$  layer violet when shaken with  $CCl_4$  and acidified solution of  $KI$ ?

- 1)  $FeCl_3$                       2)  $CuCl_2$                       3)  $ZnCl_2$                       4)  $NaOCl$                       5)  $MnO_2$

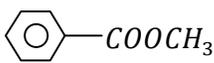
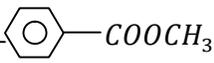
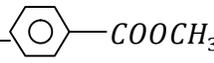
05)  $A_{x(g)} \rightleftharpoons x A_{(g)}$ When 3 moles of  $A_x$  gas placed initially in a rigid closed container when 20% of  $A_x$  gas is converted to  $A$  gas at equilibrium an equimolar mixture of  $A_x$  and  $A$  is at this equilibrium The value of  $x$  is,

- 1) 2                      2) 3                      3) 4                      4) 6                      5) 8

06) The volume of  $0.01 \text{ mol dm}^{-3}$  dilute  $H_2SO_4$  required to react with  $0.114g$  of  $CH_2 = CH - CH_2NH_2$  is

- 1)  $25cm^3$                       2)  $50cm^3$                       3)  $100cm^3$                       4)  $200cm^3$                       5)  $400cm^3$

07) Which arrangement of compounds given below, gives the correct increasing order of alkaline hydrolysis

a)   $COOCH_3$                       b)  $Cl$ —— $COOCH_3$   
c)  $CH_3O$ —— $COOCH_3$                       d)  $O_2N$ —— $COOCH_3$

- 1)  $a < b < c < d$                       2)  $b < c < d < a$                       3)  $c < d < a < b$   
4)  $c < a < b < d$                       5)  $d < b < a < c$

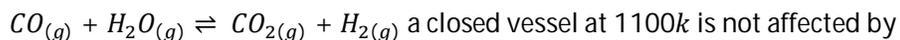
08) Which arrangement of compounds given below, gives the correct increasing order of base strength

(a)  $\text{CH}_3\text{NH}_2$  (b)  $(\text{CH}_3)_2\text{NH}$  (c)  $\text{C}_6\text{H}_5\text{NH}_2$  (d)  $\text{C}_6\text{H}_5\text{NHCH}_3$  (e)  $\text{NH}_3$

1)  $a < b < c < d < e$       2)  $b < a < e < d < c$       3)  $c < d < e < a < b$

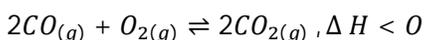
4)  $d < e < c < a < b$       5)  $e < c < d < a < b$

09) The equilibrium partial pressure of hydrogen in the reaction



- 1) Changing the total pressure
- 2) adding iron filings
- 3) adding calcium oxide
- 4) increasing the partial pressure of carbon monoxide
- 5) adding nitrogen at 1100k so that the total number of molecules present is doubled

10) Assuming equilibrium is reached in the reaction



a greater equilibrium yield of carbon dioxide will best be obtained by

- 1) raising the temperature and pressure
  - 2) lowering the temperature and pressure
  - 3) lowering the temperature and raising the pressure
  - 4) adding a catalyst and raising the pressure
  - 5) adding the noble gas
- 11) A doubling of the rate of a gas reaction in a closed vessel by raising the temperature by  $10^\circ\text{C}$  is best attributed to a doubling of the.
- 1) Average molecular velocity
  - 2) Pressure inside the vessel
  - 3) Average molecular energy
  - 4) Proportion of molecules possessing the minimum energy required for reaction.
  - 5) Molecular collision

12) The following data was obtained for the reaction in aqueous solution at  $25^\circ\text{C}$



Experiment	Initial $[\text{X}]/\text{mol dm}^{-3}$	Initial $[\text{Y}]/\text{mol dm}^{-3}$	Initial Rate of formation of Z $\text{mol dm}^{-3}\text{s}^{-1}$
1	0.2	0.2	0.04
2	0.2	0.4	0.16
3	0.4	0.4	0.16

The rate of the reaction is proportional to

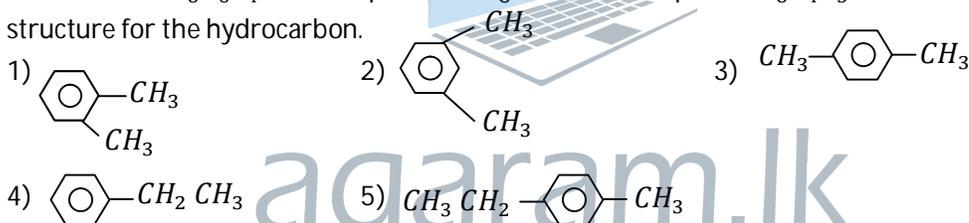
- 1)  $[\text{X}][\text{Y}]$
- 2)  $[\text{Y}]$
- 3)  $[\text{X}]^2[\text{Y}]$
- 4)  $[\text{Y}]^2$
- 5)  $[\text{X}][\text{Y}]^2$

- 13) If the heat energy change of hydrogenation of ethene is  $-x \text{ kJ mol}^{-1}$  the heat liberated (in  $\text{kJ mol}^{-1}$ ) when styrene is fully hydrogenated is likely to be
- 1) about  $x$
  - 2)  $4x$  with experimental error
  - 3) Significantly more than  $4x$
  - 4) Between  $2x$  and  $4x$
  - 5) No reliable estimate can be made since ethane and styrene are not isomers.

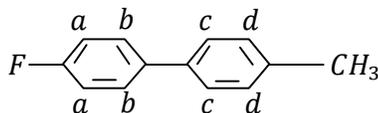
- 14) Which statement is necessarily true of isomers?
- 1) They are hydrocarbons
  - 2) They yield the same products when completely burned in oxygen
  - 3) They contain same functional groups
  - 4) They are optically active
  - 5) They have the same structural formulae

- 15) In which compound is the chlorine atom likely to be most firmly attached to carbon?
- 1)  $\text{C}_6\text{H}_5\text{Cl}$
  - 2)  $\text{CH}_3\text{Cl}$
  - 3)  $\text{CH}_2 = \text{CHCl}$
  - 4)  $\text{CH}_2 = \text{CH} - \text{CH}_2\text{Cl}$
  - 5)  $(\text{CH}_3)_3\text{CCl}$

- 16) A hydrocarbon  $\text{C}_8\text{H}_{10}$  when treated with acidified potassium permanganate solution yields a dibasic acid  $\text{C}_8\text{H}_6\text{O}_4$  which upon heating forms a compound  $\text{C}_8\text{H}_4\text{O}_3$  select the most likely structure for the hydrocarbon.



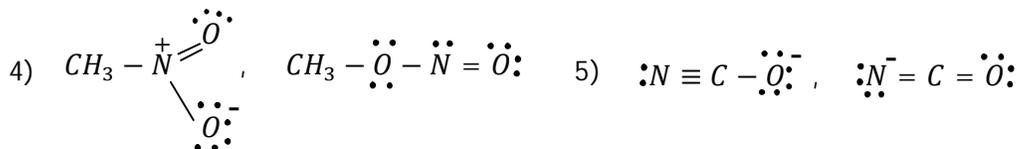
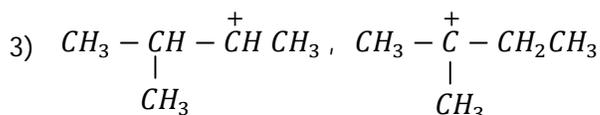
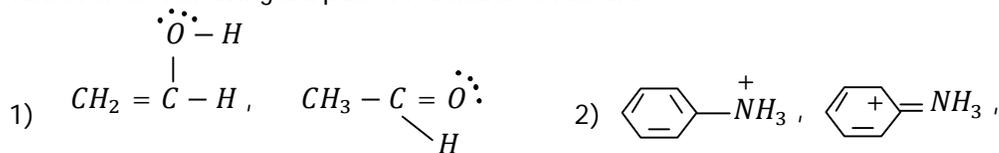
- 17) Consider the following compound,



At what positions will bromination occur when the above compound is treated with  $\text{Br}_2/\text{FeBr}_3$

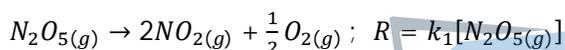
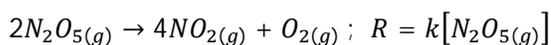
- 1)  $a$
- 2)  $b$
- 3)  $c$
- 4)  $d$
- 5)  $a, c$

- 18) Which of the following is a pair of resonance structures



- 19) Which of the following statements regarding d – block element is correct?
- 1) All elements form coloured complexes
  - 2) All elements form *oxo* anions.
  - 3) All elements contain unpaired electrons
  - 4) Electro negativity of all elements is greater than all s – block elements.
  - 5) All elements react with acid
- 20) Which one of the following statements is correct regarding  $[Cr Br(NH_3)_5]SO_4$
- 1) It has only co-ordinate and ionic bonds.
  - 2) Its IUPAC name is penta ammine bromido chromium (II) sulphate
  - 3) Its isomer produces  $AgBr$  precipitate when treated in  $AgNO_3$  aqueous solution
  - 4) Its isomer produces  $BaSO_4$  precipitate when treated in  $Ba(NO_3)_2$  aqueous solution.
  - 5) When it was treated with concentrated HCL solution pink coloured solution was obtained.

- 21) For the first – order decomposition reaction of  $N_2O_5$  it is found that



Which of the following is true?

- 1)  $k = k_1$                       2)  $k^2 = k_1$                       3)  $k_1^2 = k$                       4)  $2k = k_1$                       5)  $2k_1 = k$

- 22) Which of the following statements is not true

- 1) Catalyst does not affect the overall enthalpy change of the reaction
- 2) Catalyst does not changes the value of equilibrium constant of the reaction
- 3) The mechanism of a catalytic reaction depends on the type of catalyst
- 4) The efficiency of a solid catalyst depends upon its surface area
- 5) Catalyst is a substance which supplies energy to the reaction

- 23) For a first order reaction the time taken to reduce initial concentration by a factor of  $\frac{1}{4}$  is 8min. The time required to reduce initial concentration by a factor of  $\frac{1}{32}$  will be

- 1) 40 min                      2) 20min                      3) 16 min                      4) 12 min                      5) 10min

- 24) For the reaction  $PCL_{5(g)} \rightleftharpoons PCL_{3(g)} + Cl_{2(g)}$ , the total pressure of the system at equilibrium is found to be  $P$ , the equilibrium constant is  $K_p$ . The degree of dissociation ( $\alpha$ ) of  $PCL_5$  is

- 1)  $\sqrt{\frac{kp}{4+kp}}$                       2)  $\sqrt{\frac{kp}{4p+kp}}$                       3)  $\frac{kp}{4+kp}$                       4)  $\frac{kp}{4p+kp}$                       5)  $\frac{p kp}{4+p kp}$

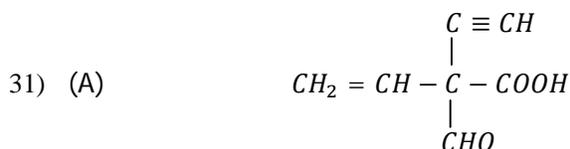
- 25) Which of the following columns 1 – 5, contains the correct observations for both tests A and B performed on aqueous solutions of the tespective salts?

	1) $CuSO_4$	2) $Ba(OH)_2$	3) $SrCl_2$	4) $Cd(NO_3)_2$	5) $AgNO_3$
A. adding dil $NH_4OH$	Light blue ppt	no ppt	no ppt	white ppt	white ppt
B. adding $NaCl_{(aq)}$ and passing $CO_2$ through the solution	white ppt	no ppt	white ppt	white ppt	no ppt

- 26) The decomposition reaction  $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$  was started with pure  $PCl_5$  at pressure  $1 \times 10^5 \text{ pa}$  in rigid closed vessel. The total pressure at equilibrium was found to be  $12 \times 10^5 \text{ pa}$  at the same temperature. The equilibrium constant  $K_p$  of the reaction would be  
 1)  $2000Pa$       2)  $5000Pa$       3)  $8000Pa$       4)  $10000Pa$       5)  $20000Pa$
- 27) The equilibrium constant  $K_p$  of the reaction  $A_{2(g)} + B_{2(g)} \rightleftharpoons 2AB_{(g)}$  is 64. If 1 mol of  $A_2$  and 1 mol of  $B_2$  are mixed the amount of  $AB$  at equilibrium would be  
 1)  $0.4 \text{ mol}$       2)  $0.8 \text{ mol}$       3)  $1.2 \text{ mol}$       4)  $1.6 \text{ mol}$       5)  $1.8 \text{ mol}$
- 28) The gaseous reaction  $A_{(g)} \rightarrow 2B_{(g)} + 3C_{(g)}$  is found to be first order with respect to  $A$ . If the reaction is started with pure  $A$  pressure pressure after  $T$  sec is found to be  $P$ . The rate of reaction at time  $T$  is proportional to  
 1)  $3P^0 - P$       2)  $5P^0 - P$       3)  $P - P_0$       4)  $2P - P_0$       5)  $P - 2P_0$
- 29) The hydrolysis of an ester was carried out separately with  $0.05 \text{ mol dm}^{-3} \text{ HCl}$  and  $0.05 \text{ mol dm}^{-3} \text{ H}_2\text{SO}_4$  which of the following will be true?  
 1)  $K_{\text{HCl}} > K_{\text{H}_2\text{SO}_4}$       2)  $K_{\text{HCl}} < K_{\text{H}_2\text{SO}_4}$       3)  $K_{\text{HCl}} = K_{\text{H}_2\text{SO}_4}$   
 4)  $2K_{\text{HCl}} = K_{\text{H}_2\text{SO}_4}$       5)  $2K_{\text{H}_2\text{SO}_4} = K_{\text{HCl}}$
- 30) The reaction  $2A + B \rightarrow 2C + 3D$  is first order with respect to  $A$  and zero order with respect to  $B$ . The rate constant of the reaction at temperature  $T$  is  $K$ .  $a$  mole of  $A$  and  $a$  mole of  $B$  were mixed and allowed to react in a rigid container of volume  $V$ . The rate of reaction at time  $t$  is  $R$ , the total amount of moles of the vessel at time is given by  
 1)  $3a - \frac{RV}{K}$       2)  $2a - \left(\frac{RV}{K}\right)^{1/2}$       3)  $2a - \frac{K}{RV}$   
 4)  $\frac{RV}{K} - 3a$       5)  $2a - \left(\frac{K}{RV}\right)^{1/2}$

❖ Instructions for question no31 to 40

1	2	3	4	5
Only (a) and (b) are correct	Only (b) and (c) are correct	Only (c) and (d) are correct	Only (d) and (a) are correct	Any other number or combination of response is correct.



A is treated with

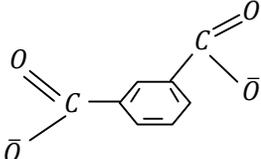
- Ni /  $H_2$  the product does not show optical activity
- $LiAlH_4$  and then resultant is neutralized that product does not show optical activity.
- $H_2 / Pd - BasO_4 /$  quinoline, the product does not show optical activity.
- Tollens reagent, the product does not show optical activity.

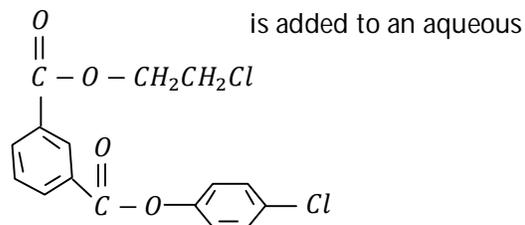
32) Which of the following would take place when solution of  $NaOH$

a)  $HOCH_2CH_2OH$  is formed

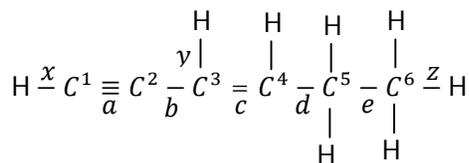
b)  $Na^+ \bar{O} - \text{C}_6\text{H}_4 - \bar{O} Na^+$  is formed

c)  $HOCH_2CH_2Cl$  is formed

d)  is formed



33) Which of the following statements regarding the molecule



are, true

a) The  $C - H$  bond lengths increase in the order  $x < y < z$

b) The  $C - C$  bond lengths increase in the order  $a < c < e < d < b$

c) The electro negativity of carbon atoms increase in the order  $1 < 3 < 5$

d) Carbon atoms labeled as 1, 2 and 3 lie in a straight line

34) Which of the following statements are correct

a) When  $BaO_2$  reacts with a dilute acid it gives hydrogen peroxide

b) Divalent tin or lead compounds are essentially ionic in nature where as tetravalent compounds are generally covalent

c) Stannic chloride is insoluble in benzene

d) aluminium chloride is a strong lewis base

35) Which of the following statements are correct

a)  $N_2O_4$  involves  $N - N$  bond which is longer than the  $N - N$  bond  $N_2H_4$

b) The enthalpy change of formation of  $N_2O_4$  is positive

c)  $N_2O_3$  readily dissociates to give  $NO$  and  $NO_2$  at R.T.P

d)  $N_2O_4$  is a planer molecule

36) Which of the following salts does not release a mixture of  $NO_2$  and  $O_2$  on strong heating

a)  $NH_4NO_3$

b)  $NaNO_3$

c)  $Cu(NO_3)_2$

d)  $AgNO_3$

37) The pair of compounds which can exist together in aqueous solution are

a)  $K_2CO_3, NaHCO_3$

b)  $K_2CO_3, NaOH$

c)  $KHCO_3, KOH$

d)  $NaH_2PO_2, KOH$

38) Which of the following statements are correct

a)  $FeCl_3$  aqueous solution gives a light green solution with Zn

b)  $FeCl_3$  aqueous solution reacts with  $SnCl_2$  to give  $SnCl_4$

c)  $FeCl_3$  aqueous solution given greenish yellow with  $NH_4SCN$

d)  $FeCl_3$  aqueous solution reacts with atmospheric oxygen to give brown precipitate.

- 39) Which of the following statements are correct?
- At 298k the average kinetic energy of  $SO_2$  is greater than  $O_2$  gas.
  - Equal masses of all gases occupy the same volume at STP
  - A real gas cannot be liquefied above critical temperature
  - Gases having very low critical temperatures often show near ideal gas behavior at room temperature.
- 40) Which of the following statements are correct?
- The rate of an endothermic reaction increases with increasing temperature.
  - Order of a reaction is always determined experimentally
  - The catalyst converts an endothermic reaction to exothermic reaction
  - At constant temperature rate of reaction depends only on the initial concentration of the reactants

❖ **Instruction for question 41 to 50**

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

	Statement - 1	Statement -2
41)	F atom has less negative electron affinity than Cl atom	Additional electrons are repelled more effectively by 2p electrons in F atom than by 3p electrons in Cl atom
42)	On descending in Group 13, +1 oxidation state becomes less stable than +3 state	The inert pair effect becomes dominant on descending Group 13
43)	$H_2F_2$ exists in gaseous form at room temperature	Hydrogen bonding is present only when the substance exists as liquid or solid form
44)	All pure crystalline substance is expected to have zero entropy at 0k	The volume occupied by the molecules of an ideal gas is zero
45)	The value of $K_p$ is greater than that of $K_c$ for a reaction involving $\Delta n(gas) > 0$	The relation between $K_p$ and $K_c$ is $K_p = K_c(RT)^{\Delta n}$
46)	The degree of dissociation $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ is not affected by the variation of volume of the system	$K_p$ of the reaction is independent of the pressure of the system
47)	A first order reaction never reaches the completion state	The concentration of reactant decreases exponentially
48)	Resonance effect in a species generally makes it more stable	Resonance is caused by the movement of delocalized electrons
49)	p -nitro aniline is more basic than p -chloro aniline	The nitro group is more effective than chloro group in weakening the basic nature of aniline
50)	Brown ring test of $NO_3^-$ cannot be performed satisfactorily if the solution also contains $Br^-$ ions	Halogen $Br_2$ is released from halides having $Br^-$ when treated with concentrated $H_2SO_4$



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Grade :- 13 (2016)

Chemistry - II

Time :- Three hours

Part II - A  
Structured Essay

❖ answer all four question on this paper itself

1)

a) You are provided with the following list of compounds.



Which one of the above compounds.

i) Gives a blue coloured solution on addition of excess  $NH_4OH$  to its aqueous solution  
.....

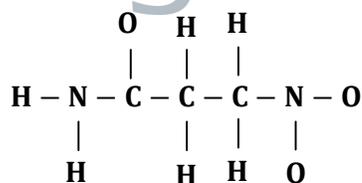
ii) Gives a dark orange precipitate when dissolved in  $HCl$  and  $H_2S$  is passed .....

iii) Gives a blue coloured solution on addition of excess concentrated  $HCl$  to its aqueous solution .....

iv) Is used as a primary standard in volumetric analysis .....

v) Undergoes hydrolysis to give an acid with a tetrahedral structure .....

b) The following parts (i) – (vi) are based on the compound of molecular formula  $C_3H_6N_2O_3$ .  
the skeleton of  $C_3H_6N_2O_3$  is given below



I) Draw the most acceptable Lewis structure for this molecule

II) Draw resonance structures for this molecule and comment on their relative stabilities.

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.....



2) a)

i) State and explain the difference in the behavior of tetra chloro methane and silicon tetrachloride towards water.

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.....  
.....

ii) Write an equation to represent the reaction of  $PbCl_4$  with water

.....

iii) Aqueous tin (II) chloride is a strong reducing agent, Write an equation for the reaction of aqueous tin (II) chloride with aqueous Iron (III) chloride.

.....

iv) Explain why aqueous solution of tin (II) chloride are stored in contact with metallic tin.

.....

b)

i) Write down the ground state electronic configurations, in terms of s, p and d electrons of

1) a copper atom : .....

2) a copper (II) ion : .....

ii) When copper (II) carbonate is dissolved in the minimum quantity of concentrated HCl, a yellow solution is obtained when water is added to this solution the colour changes from yellow through a green to light blue colour of aqueous copper(II) salt

1. Suggest a formulae for the copper(II) complex in the yellow solution

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2. Explain why the colour changes upon the addition of water

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3. Describe what would be observed in each of the following and write appropriate equations for the reactions.

a) Aqueous KI is added to in  $CUSO_4$  aqueous

.....

b) Aqueous ammonia is added to aqueous  $CUSO_4$

.....

4. Suggest the reagents and essential experimental conditions for a method that might be used to prepare the following from metallic copper

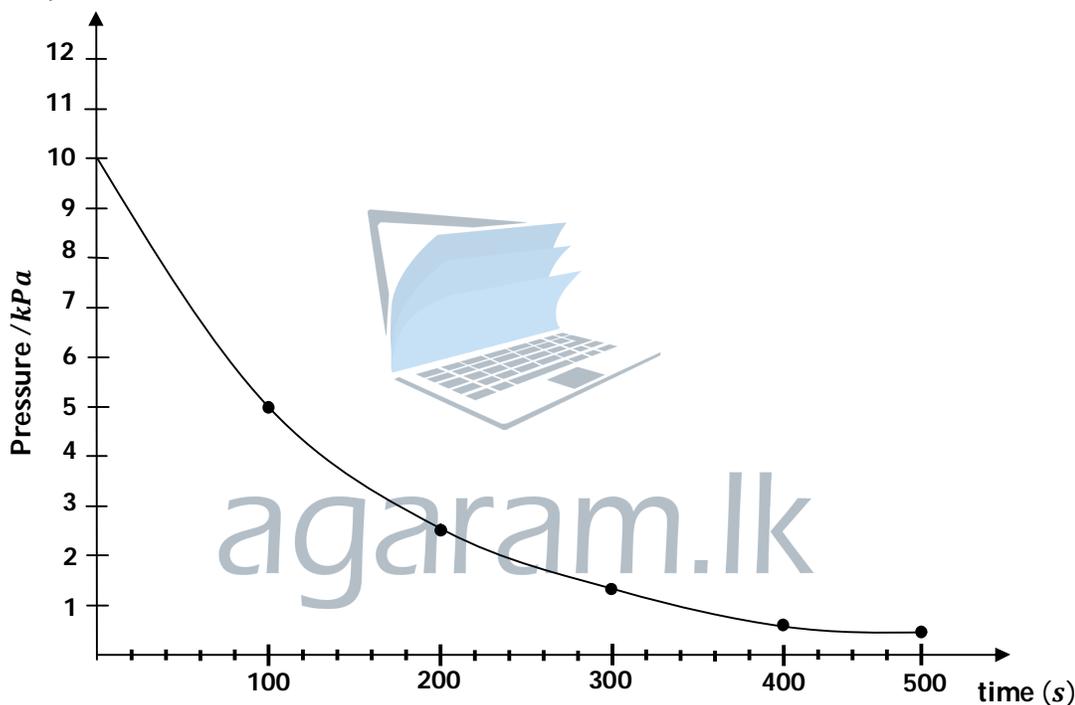
a) copper(II) oxide

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.....

b) Copper(I) chloride

.....  
.....

3) The following graph refers to the pressure of gaseous dinitrogen pentoxide ( $N_2O_5$ ) during its decomposition at  $65^\circ C$



a) i) For initial pressures of  $10kPa$ ,  $8kPa$ ,  $6kPa$  and  $4kPa$  determine the time to the nearest ten seconds for each pressure to become half.

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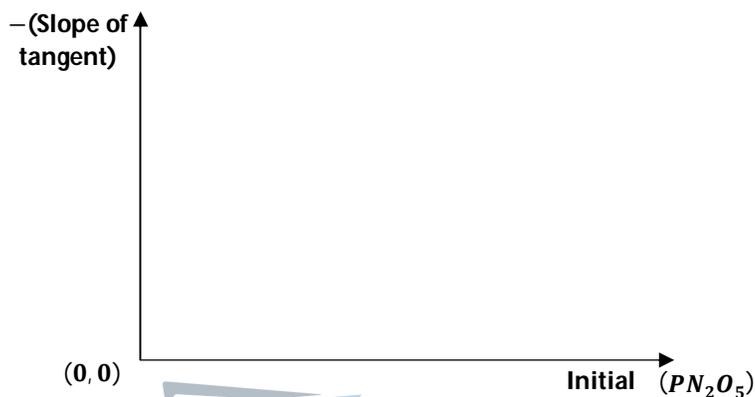
ii) Use the above four answer to determine the order of the reaction and explain the reasons for your answer.

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

iii) What information would be given by the slope (gradient) of a tangent drawn to the curve at any point?

.....  
 .....

iv) Sketch the graph you would expect if you plot the negative slopes of the tangents to various points on the curve against the pressures of  $N_2O_5$  at those points.



b) At  $800\text{K}$  the decomposition of  $PCl_5(g)$  is a first order reaction  
 $a$  is the initial number of  $PCl_5$  molecules at pressure,  $P_0$  at constant volume of vessel. The decomposition is followed by measuring the total pressure  $P_t$  at time  $t$ .  $x$  is the number of  $PCl_5$  molecules that have decomposed after a time  $t$ .

When  $t = 0$ ,  $P_0 \propto a$  write similar expressions, using  $a$  and / or  $x$  for the

I) i) Partial pressure ( $P_{Cl_2}$ ) of chlorine in the vessel at time  $t$ .

.....  
 .....

ii) Partial pressure ( $P_{PCl_5}$ ) of  $PCl_5$  in the vessel at time  $t$ .

.....  
 .....

iii) Total pressure  $P_t$  of the vessel at time  $t$ .

.....  
 .....

II) i) Write an expression for  $\frac{a}{a-x}$  in terms of  $P_0$  and  $P_t$ .

.....  
 .....

ii) When  $t = 0$ , the initial pressure is  $100\text{kPa}$  and  $t = 30\text{ sec}$ , the total pressure of the vessel is  $120\text{kPa}$ . calculate the value of  $\frac{a}{a-x}$  after 30 seconds.

.....  
 .....

- 4) a) The elements present in an organic compound A and their mass percentages are given below

	C	H	N
mass %	54.55	13.63	31.82

- i) Deduce the empirical formula of A ( $C - 12, H - 1, N - 14$ )

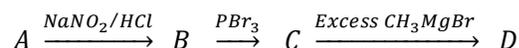
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- ii) Write the molecular formula of A :-

.....

- iii) A has four stereoisomers, A undergoes the following reaction



Write the structures of A, B, C and D in the relevant cages



**A**



**B**



**C**



**D**

- b) Starting from ethanol and selecting appropriate reagent and solvents only from those give below, show how you would synthesize the compound



Reagents and solvents :  $Zn, Hg, Mg, Br_2$  dry ether,  $PBr_3$ ,  $dil NaOH$ , Cone  $HCl$ ,  $CCl_4$

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.....

- c) Methyl benzene  $C_6H_5CH_3$  is nitrated in a similar way to benzene. The organic compound formed is 4 - nitromethyl benzene.

- i) Draw the structure of 4-nitromethyl benzene

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- ii) State the reagents for this reaction

.....

- iii) Name the type of mechanism

.....

- iv) Describe, with the aid of curved arrows, the mechanism of the reaction

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G.C.E. A/L Examination November - 2015  
Conducted by Field Work Centre, Thondaimanaru  
In Collaboration with  
Zonal Department of Education Jaffna.

Grade :- 13 (2016)

Chemistry - II

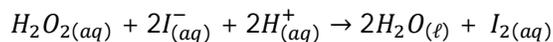
Part - B

Essay

Answer only two questions

- 5) a) i) State Le–chatelier’s principle  
ii) In relation to the following equilibria  
Equilibrium I  $2NH_{3(g)} \rightleftharpoons N_{2(g)} + 3H_{2(g)}, \Delta H > 0$   
Equilibrium II  $2CrO_4^{2-}(aq) + 2H^+(aq) \rightleftharpoons Cr_2O_7^{2-} + H_2O(l)$   
Use Le–chatelier’s principle to predict and explain the effect of  
1) increasing the pressure on equilibrium I  
2) increasing the temperature on Equilibrium I  
3) Increasing the concentration of  $H^+(aq)$  on equilibrium II
- iii) When a 2 : 1 ratio of  $SO_2$  and  $O_2$  at a total initial pressure of  $3 \times 10^5 Pa$  is passed over a catalyst at  $500^\circ C$ , the partial pressure of  $SO_3$  at equilibrium is found to be  $1.8 \times 10^5 Pa$   
1) Calculate the partial pressures of  $SO_2$  and  $O_2$  at equilibrium and hence the new total pressure and the percentage conversion of  $SO_2$  into  $SO_3$   
2) Write an expression for the equilibrium constant,  $K_p$  and calculate its value at  $500^\circ C$ .  $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$
- b) Consider the chemical reaction  
 $N_{2(g)} + O_{2(g)} \rightarrow 2NO(g)$   
and the thermo chemical data given below at  $25^\circ C$
- | Chemical Species                  | $N_{2(g)}$ | $O_{2(g)}$ | $NO(g)$ |
|-----------------------------------|------------|------------|---------|
| $\Delta H_f^\ominus / KJmol^{-1}$ | 0.00       | 0.00       | +90.40  |
| $S^\ominus / Jmol^{-1}K^{-1}$     | 191.50     | 205.00     | 210.60  |
- i) Calculate  $\Delta H^\ominus$  for the above reaction at  $25^\circ C$   
ii) Calculate  $\Delta S^\ominus$  for the above reaction at  $25^\circ C$   
iii) Calculate  $\Delta G^\ominus$  for the above reaction at  $25^\circ C$   
iv) At what minimum temperature will the reaction given above become spontaneous.

- 6) a) The kinetics of the following reaction can be studied by measuring initial rates.



Four experiments carried out with initial concentration of  $H_2O_2$ ,  $H^+$  and  $I^-$  at a given temperature are described in the following table. Concentration of  $I_2$  with time (t/sec) was measured

Experiment No	Initial concentration / $mol\,dm^{-3}$			Formation of $[I_2]$ / ( $mol\,dm^{-3}$ )	time (t)/s
	$[H_2O_2]$	$[I^-]$	$[H^+]$		
1	0.2	0.2	0.2	$2 \times 10^{-3}$	10
2	0.4	0.2	0.2	$8 \times 10^{-3}$	20
3	0.2	0.4	0.2	$3 \times 10^{-3}$	15
4	0.2	0.2	0.4	$6 \times 10^{-3}$	15

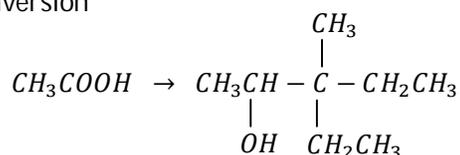
- Calculate the order of the above reaction with respect to each reactants  $H_2O_2$ ,  $H^+$  and  $I^-$
- Deduce the overall order of the reaction?
- Calculate the rate constant ( $k$ )
- In another experiment if the concentration are  $[H_2O_2] = 1 \times 10^{-4} mol\,dm^{-3}$ ,  $[H_{(aq)}^+] = 4 mol\,dm^{-3}$  and  $[I_{(aq)}^-] = 4 mol\,dm^{-3}$  show that the expression for the rate of reaction can be given by rate =  $K^1[H_2O_2]$
- State the assumption made in deriving the expression in (iv) above
- In the above (iv) experiment the concentration of  $[H_2O_2]_0$  changes with time according to the following equation

$$2.303 \log_{10}[H_2O_2] = -K^1t + 2.303 \log_{10}[H_2O_2]_0$$

$[H_2O_2]$  is the initial concentration of  $H_2O_2$  show that the half life ( $t_{\frac{1}{2}}$ ) of the reaction is given by  $0.693/K^1$  and calculate  $t_{\frac{1}{2}}$  using the data in (iii) and (iv) above

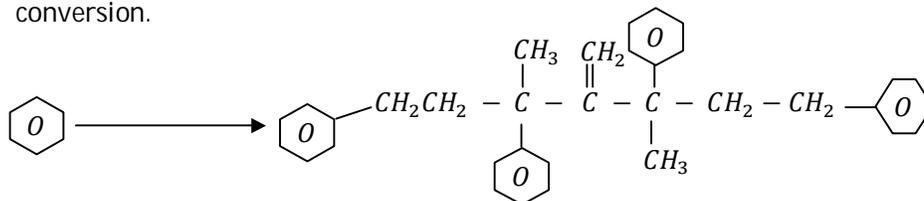
- b) A natural gas may be assumed to be a mixture of methane and ethane. On complete combustion of the  $20dm^3$  of the gas at s.t.p the heat evolved was  $990KJ$  Assuming  $\Delta H_c [CH_{4(g)}] = -890KJ\,mol^{-1}$  and  $\Delta H_c [C_2H_{6(g)}] = -1560KJ\,mol^{-1}$  calculate the percentage of volume of  $CH_4$  gas in the mixture

- 7) a) Give a mechanism for chlorination of benzene in the presence of anhydrous  $AlCl_3$   
 b) Using only the chemical substances given in the list, show how you would carry out the following conversion



( $Mg$ ,  $PCl_5$ ,  $H_2O$ , Dil  $H_2SO_4$ ,  $KMnO_4$ ,  $LiAlH_4$ , Dry ether)

- c) Using only the chemicals given in the list, show how you would carry out the following conversion.



( $\text{PBr}_3$ , Dil  $\text{NaOH}$ , Conc  $\text{HCl}$ , Conc  $\text{H}_2\text{SO}_4$ ,  $\text{Mg}$ , dry  $\text{AlCl}_3$ ,  $\text{Zn}$ , dry ether,  $\text{CH}_3\text{COCl}$ )

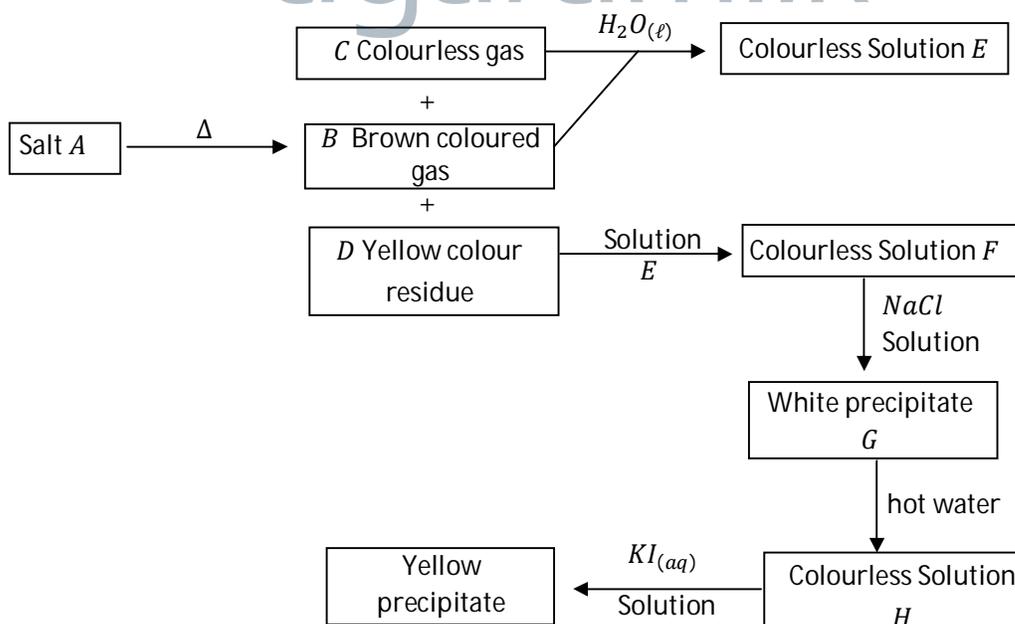
- d) Explain why acid amides are not very reactive towards nucleophilic attack

### Part – C

#### Essay

#### Answer two questions only

- 8) a) Compound A is a crystalline solid when A is heated, it gives a colourless gas B and a residue C. The residue C dissolves in dilute  $\text{HCl}$  and the resulting solution gives a brown precipitate D on addition of potassium ferrocyanide solution. The gas B is passed into an acidified  $\text{KMnO}_4$  solution. The pink colour does not disappear. A dissolves in dilute  $\text{H}_2\text{SO}_4$  with the evolution of a gas which is identical in all respects with B. The solution of A obtained above gives a white precipitate E on addition of  $\text{KI}$  solution
- Identify the species A, B, C, D, E
  - Give the balanced chemical equations for above reactions.
- b) Reactions of compounds of an element in the p – block of the periodic table are given below. Identify the species A, B, C, D, E, F, G, H, I



Give the balanced Chemical equations for above reactions.

- C) 4 g of a mixture  $NaOH$  and  $KOH$  was dissolved in water and volume of the solution was made up to  $250\text{cm}^3$ ,  $25\text{cm}^3$  of this solution required  $40\text{cm}^3$  of  $0.2\text{mol dm}^{-3} HCl$  for complete neutralization. Calculate the mass percentage of  $NaOH$   
( $Na - 23, K - 39, O - 16, H - 1$ )
- 9) a)  $XY$  and  $XY_2$  are two gases formed by the elements  $X$  and  $Y$ ,  $X$  is a solid at the room temperature whereas  $Y_2$  is a gas
- $XY_2$  dissolves in water giving acidic solution
  - The oxidation state of  $X$  in  $XY$  is  $+2$  and  $XY_2$  it is  $+4$
  - $XY$  is heated with air to form  $XY_2$
  - In high temperature  $XY_2$  reacts with  $x$  to form  $XY$
  - When  $XY_2$  is passed into a  $Ba(OH)_2$  aqueous solution, a white precipitate is formed.
  - $XY$  is passed through heated  $ZnO$  to form element of  $Zn$ 
    - Identify the gases  $XY$  and  $XY_2$
    - Write the balanced chemical equations occurring in A, C, D, E and F
    - Give the industrial use of  $X$
    - Give the industrial use of  $XY_2$
- b) The following questions are based on the oxides of nitrogen.
- Write the chemical formula and common names of nitrogen oxides  
Give the oxidation number of nitrogen in each oxide you identified. Indicate whether each oxide is acidic, basic or neutral
  - Indicate how the above oxides can be prepared in laboratory
  - Draw the very unstable resonance structure of the oxide of nitrogen where the oxidation number of nitrogen is  $+5$
- c) 10.0g sample contained  $Fe_2O_3$ ,  $Fe_3O_4$  and inert material. It was dissolved in dilute  $H_2SO_4$  and volume of the solution was made up to  $250\text{cm}^3$ . An excess of  $KI$  solution was added to the  $25\text{cm}^3$  of prepared solution. The liberated iodine in this solution required  $40\text{cm}^3$  of  $0.2\text{mol dm}^{-3} Na_2S_2O_3$  for reduction to iodide. Another  $25\text{cm}^3$  solution was separated, after which the  $Fe^{2+}$  ions were titrated against  $0.01\text{mol dm}^{-3} KMnO_4$  in acidic medium. The volume of  $KMnO_4$  solution used was found to be  $40\text{cm}^3$ . Calculate the mass percentage of  $Fe_3O_4$  and  $Fe_2O_3$  in the original mixture ( $Fe - 56, O - 16$ )
- 10) a) A is a water soluble crystalline compound. Given below are some tests carried out to identify A.
- A reacts with potassium dichromate in the presence of concentrated sulphuric acid to give red vapour.
  - Above vapours when passed through sodium hydroxide solution a yellow solution is obtained.

- iii. The addition of lead acetate to the above solution (ii) gives yellow precipitate.
- iv. Above solution (ii) is made acidic with dilute sulphuric acid to obtain orange colour solution.
- v. When A is heated with  $NaOH$  solution a colour less gas is evolved
- 1). Identify A
  - 2). Write the balanced chemical equations occurring in (i) (ii) (iii) (iv) and (v)
- b) A is an element which reacts with water and does not give peroxide on burning in air and form mono acidic base
- (i)  $A \xrightarrow[\Delta]{air} B_{(s)} + C_{(s)}$
  - (ii)  $B \xrightarrow{H_2O(l)} D_{(aq)} + E_{(g)}$
  - (iii)  $E_{(g)} \xrightarrow[reagent]{Nessler's} \text{Brown ppt}$
  - (iv)  $D_{(aq)} \xrightarrow{CO_2(g)} \text{White ppt (F)}$ 
    - 1). Name substances relevant to given symbols in above reaction sequence
    - 2). Write balanced chemical equations occurring in (1), (2) and (4)
- c) A sample of 1.0g of  $CuSO_4 \cdot 5H_2O$  is dissolved and made up to  $250cm^3$ , A  $25cm^3$  portion is added to an excess of potassium iodide. The iodine formed required  $40cm^3$  of a  $0.01mol\ dm^{-3}$  solution of sodium thio sulphate for reduction. Calculate percentage of copper in the crystals ( $Cu - 64$ )
- d) The following table concerning the action of heat on four compounds.

Compound heated		Solid formed		Gas formed
Name	Colour	Name	Colour	Name
1. Lead carbonate	A	B	Yellow	C
2. Sodium nitrate	D	E	F	G
3. H	Blue	H	White	Steam
4. Calcium oxalate	J	K	L	M

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