වයඹ පළාත් අධ්‍යාපන දෙපාර්තමේන්තුව

Provincial Department of Education - NWP

02 | E | I

Third Term Test - Grade 13 - 2018

Index No : ....

Chemistry I

Two Hours

Important

- Periodic Table is provided.
- Answer all the questions.
- Use of calculator is not allowed.
- Write your Index number in the space provided in the answer sheet.
- In each of the questions 1 to 50, pick one of the alternatives form (1), (2), (3), (4), (5) which is correct or most appropriate and mark your response on the answer sheet with a cross (x) in accordance with the instructions given on the back of the answer sheet.

Universal gas constant $R = 8.314\ JK^{-1}\ mol^{-1}$	Avogadro constant $N_A = 6.022 \times 10^{23}\ mol^{-1}$
Planck's constant $h = 6.626 \times 10^{-34}\ Js$	Velocity of light $C = 3 \times 10^{8}\ ms^{-1}$

1. The scientists who contributed for creating the period table are,
   1. Newlands, Thompson
   2. Mendeleev, Lother Mayer
   3. Newlands, William crooks
   4. Chadwick, Thompson
   5. Rutherford , Chadwick

2. Which of the following statements is true regarding the provided molecules below?
   NO_2 , OF_2 , CS_2 , NCl_3 , SiF_4
   1. All molecules have different shapes.
   2. There are not dative bonds in any molecule.
   3. Every molecule obeys the octet rule.
   4. The number of molecules having lone pairs are greater than two.
   5. There is not any molecule given here which is having unpaired electrons.

3. What is the IUPAC name of the following compound?

$$CH_3 - \underset{\underset{CH_2CH_3}{|}}{\overset{\overset{H}{|}}{C}} - \overset{\overset{OH}{|}}{C} = \overset{\overset{CHO}{|}}{C} - \overset{\overset{O}{||}}{C} - O - CH_2CH_2CH_3$$

   1. propyl 2 – formyl – 3 – hydroxy – 4 – methyl – 2 – hexanoate
   2. propyl 2 – formyl – 3 – hydroxy – 4 – methylhex – 2 – enoate
   3. propyl 2 – formyl – 3 – hydroxy – 4 – ethyl – 2 – pentenoate
   4. propyl – 2 – formyl – 3 – hydroxy – 4 – ethyl – 2 – pentenoate
   5. propanol – 2 – formyl – 3 – hydroxy – 4 – ethyl – 2 – pentenoate

4. The element which shows the highest stable oxidation state is,
   1. Cr 2. F 3. N 4. Mn 5. S

5. Naphtha $(C_6H_{14}\,(g))$ gives $CO(g)$ and $H_2(g)$ in partial oxidation with oxygen. What is the mass of gases can be collected when $112l$ of naphtha is reacted under STP?
   ($O = 16\,,\ H = 1,\ C = 12$) Under STP volume of one mole of a gas is $22.4l$.
   1. 910 g 2. 182 g 3. 150 g 4. 1390 g 5. 1110 g

6. The species, which does not show the trigonal bipyramidal shape for the electron pair geometry around the central atom?
   1. PCl_5 2. SF_4 3. ClF_3 4. XeF_2 5. XeF_4

7. At 298 K, the solubility of $CaSO_4$ is $3 \times 10^{-3}\ mol\ dm^{-3}$ and the solubility of $Ca(OH)_2$ is $1 \times 10^{-2}\ mol\ dm^{-3}$. The ratio of $\frac{K_{SP}\,[\,CaSO_4\,(s)]}{K_{SP}\,[Ca(OH)_2\,(S)]}$ at 298K is, ,
   1. $\frac{9}{2}$ 2. $\frac{9}{4}$ 3. $\frac{3}{10}$ 4. 3 5. $\frac{3}{2}$

8. The number of electrons can exist for the quantum numbers $n = 4$ and $m_l = 0$ is,
   1. 4 2. 6 3 8 4. 10 5. 12

9. Which of the following statements is false regarding the S block metals ?
   1. All metals of group I react with cold water and evolve H_2 gas.
   2. Metals of group II react with conc. acids and liberate H_2 gas.
   3. When all metals of group II, are heated in air not only the oxide but also the nitride is formed.
   4. Down the group of S-block the reducing property of elements is increasing.
   5. Metals of group I react with dil. acids to evolve H_2 gas.

10. At T K temperature the total pressure of the equilibrium system,
    $2A\,(s) \rightleftharpoons 2B(s) + C\,(g) + D\,(g)$ is $4.0\ x\ 10^5\ Pa$. The value of K_P at TK is,
    1. $16 \times 10^{15}\ Pa^2$ 2. $16 \times 10^{10}\ Pa^2$ 3. $1 \times 10^{10}\ Pa^2$
    4. $4 \times 10^{20}\ Pa^4$ 5. $4 \times 10^{10}\ Pa^2$

11. The correct increasing order of the melting point of the given elements is,
    1. $Na < K < Mg < Al$ 2. Na < Mg < Al < K
    3. Na < K < Al < Mg 4. K < Na < Mg < Al
    5. K < Al < Mg < Na

12. A sodium lamp emits yellow light (580nm) it generates 2×10^{20} photons within 8 seconds. The energy released in this light per one second is,
    1. $7.23\,J$ 2. $7.05\,J$ 3. $8.56\,J$ 4. $6.81\,J$ 5. $5.95\,J$

13.

	$\Delta H\ kJmol^{-1}$	$\Delta S\ JK^{-1}Jmol^{-1}$
$C\,(S) + H_2O\,(g) \longrightarrow CO(g) + H_2(g)$	130	140
$CO_2(g) + H_2\,(g) \longrightarrow CO(g) + H_2O(g)$	40	50

    Select the true statement for the reaction, $2\,CO\,(g) \longrightarrow C\,(s) + CO_2\,(g)$
    In this reaction,
    1. $\Delta H = 170\ KJ\ mol^{-1}\ \ \Delta S = -190\ JK^{-1}mol^{-1}$
    2. $\Delta H^{\emptyset} = -170\ KJ\ mol^{-1}\ \ \Delta S^{\emptyset} = -190\ JK^{-1}mol^{-1}$
    3. $\Delta H = -170\ KJ\ mol^{-1}\ \ \Delta S = -190\ JK^{-1}mol^{-1}$
    4. $\Delta H^{\emptyset} = -180\ KJ\ mol^{-1}\ \ \Delta S^{\emptyset} = +190\ JK^{-1}mol^{-1}$
    5. $\Delta H = -90\ KJ\ mol^{-1}\ \ \Delta S = -90\ JK^{-1}mol^{-1}$

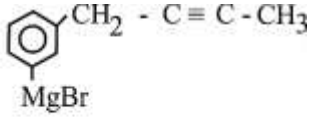
14. At $27^0\,C$ and 10 atm pressure $X(g)$ is placed in a closed rigid vessel of the volume $5\,m^3$. At $27^0\,C$ and20 atm pressure $Y\,(g)$ is placed in another closed rigid vessel of $10\,m^3$ volume. When these two vessel connected through a tube with a negligible volume, the total pressure of this system is,

1. 13.33 atm 2. 50.00 atm 3. 16.67 atm 4. 3.33 atm 5. 35.00 atm

15. At $298\,K$, $50\,cm^3$ of $0.05\,mol\,dm^{-3}$ CH_3COOH and $50\,cm^3$ of $0.025\,mol\,dm^{-3}$ KOH are mixed to from a buffer solution, If the dissociation constant of CH_3COOH acid at $298\,K$ is 1.8×10^{-5} $mol\,dm^{-3}$ the P^H value of this buffer solution is,

1. 6.74 2. 5.25 3. 4.74 4. 4.25 5. 4.52

16. The stable Grignard regent is,

(1). $CH_3 - \underset{\underset{OH}{|}}{CH}\,CH_2MgBr$ (2). 

(3). $CH_3CH_2 - \underset{\underset{MgBr}{|}}{\overset{\overset{H}{|}}{C}} - COOH$ (4). $H - C \equiv C - CH_2MgBr$

(4). $CH_3 - \overset{\overset{NH_2}{|}}{C} = \overset{\overset{H}{|}}{C} - MgBr$

17. The reaction $A + B + C \rightarrow$ product,
Proceeds through the following basic steps.
$A + C \rightleftharpoons X$ (fast)
$X + C \rightleftharpoons Y$ (fast)
$Y + B \rightleftharpoons Z$ (slow)
$Z + nC + nB \rightarrow$ products (fast)
the rate expression for the above reaction is,
1. $R = k[Y]\,[B]$ 2. $R = k[X]\,[C]$ 3. $R = k[Y]\,[B][C]$
4. $R = k[A]\,[B][C]$ 5. $R = k[A]\,[B][C]^2$

18. Which of the following statements is correct regarding the electrochemical cell prepared by using the half cells $Al^{3+}\,(1.0\,M)/\,Al(s), (E^\theta = -1.66\,V)$ and $Cu^{2+}\,(1.0\,M)/\,Cu(s), (E^\theta = 0.34\,V)$ with a salt bridge.
1. When the concentration of $Al^{3+}(aq)$ is increasing the electro motive force is increasing.
2. Here the cell reaction is $Al\,(s) + Cu^{2+}\,(aq) \longrightarrow Al^{3+}\,(aq) + Cu\,(s)$
3. To increase the electromotive force of this cell, the temperature should be reduced.
4. The ions of a half cell move to the other half cell through the salt bridge.
5. The electromotive force of this cell is 2.1 V.

19. The density of a gas sample containing CO_2 is $2.2 \times 10^{-2} g\,cm^{-3}$ When $4\,dm^3$ of this gas sample is passed through a $Ba(OH)_2$ solution, CO_2 reacts completely with $Ba(OH)_2$ and yields $1.97 \times 10^{-6}\,g$ of $BaCO_3$. The Concentration of CO_2 in the gas sample in ppm is,

1. 100 2. 200 3. 300 4. 400 5. 500

20. In which of the following compounds does not change the existing colour upon the addition of $HBr\,(aq)$?
1. K_2CrO_4 2. $BaSO_4$ 3. $AgNO_3$
4. $con\,H_2SO_4$ 5. $Pb(NO_3)_2$

21. At $298K$ for the reaction $H_2(g) + C(g) + O_2(g) \longrightarrow HCOOH(g)$ $\Delta H^\theta = -411\ kJ\ mol^{-1}$ The bond dissociation enthalpies of $H-H$, $O=O$, $C=O$, $C-O$ and $O-H$ bonds are $436\ kJ\ mol^{-1}$, $496\ kJ\ mol^{-1}$, $743\ kJ\ mol^{-1}$, $360\ kJ\ mol^{-1}$ and $436\ kJ\ mol^{-1}$ respectively. The bond dissociation enthalpy of $H-C$ bond is,

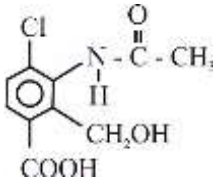
1. $-555\ Kj\ mol^{-1}$
2. $-223 Kj\ mol^{-1}$
3. $+223\ Kj\ mol^{-1}$
4. $-446\ Kj\ mol^{-1}$
5. $+446\ Kj\ mol^{-1}$

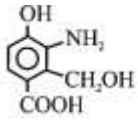
22. Which of the following statements is true regarding the 3d elements.

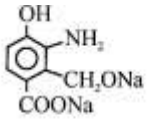
1. Only non transition elements of 3d elements form white colour oxides.
2. All the complex ions formed by aqueous cupper ions with conc. HCl is yellow in coclour.
3. The amphoteric oxides of MO_2 type are formed by Mn and Cr
4. $CuCl$ is a white colour compound which is used as catalyst.
5. All the complex formed by 3d elements with NH_3 are colourful,

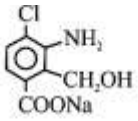
23. $AB\ (s) \leftrightharpoons C(s) + D\ (g)$
$\Delta H_f^\theta\ AB\ (s) = -1208\ kJ\ mol^{-1}$, $\Delta H_f^\theta\ C\ (s) = -600\ kJ\ mol^{-1}$,
$\Delta H_f^\theta\ D\ (g) = -500\ kJ\ mol^{-1}$
Which of the following statements is true for the above reaction.

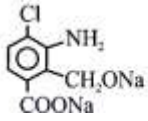
1. $\Delta H^\theta = -108\ kJ\ mol^{-1}$ and when the pressure is increasing products are formed more.
2. $\Delta H^\theta = 108\ kJ\ mol^{-1}$ and the value of Kp is increasing with increasing temperature.
3. $\Delta H^\theta = 108\ kJ\ mol^{-1}$ and value of K_C is decreasing with increasing temperature.
4. $\Delta H^\theta = 108\ kJ\ mol^{-1}$ and the value of Kp does not change although the pressure is reduced.
5. $\Delta H^\theta = 216\ kJ\ mol^{-1}$ and here $K_P = K_C RT$

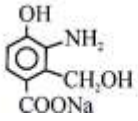
24.  What is the product obtained when this compound is reacted with $NaOH(aq)$?

(1).  , CH_3COOH

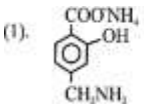
(2).  , $CH_3COO^-Na^+$

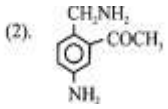
(3).  , $CH_3COO^-Na^+$

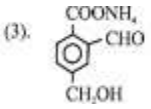
(4).  , $CH_3COO^-Na^+$

(5).  , CH_3COONa

25. The compound "A" reacts with Na_2CO_3 to form B and a gas with a pungent smell. B reacts with $NaNO_2 / HCl$ liberating N_2 gas, and C. That C reacts with $2,4-DNP$. The compound "A" should be ,

(1). 

(2). 

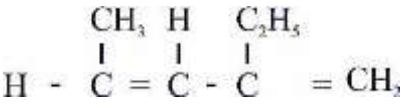
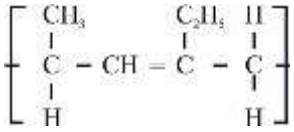
(3). 

(4). 

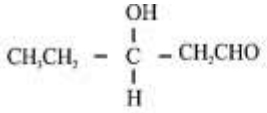
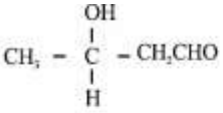
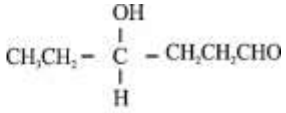
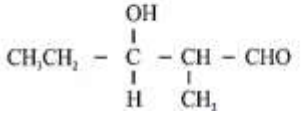
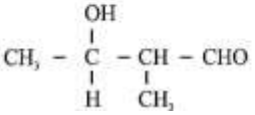
(5). 

26. Which of the following statements is false regarding the photochemical smog.
    1. $NO_{2_{(g)}}$, $CO_{(g)}$ and $CO_{2_{(g)}}$ which contain in the automobile exhausts are convert to ozone aldehydes, peroxiacytyl nitrates at the presence of sunlight and temperatures above 15^0C
    2. The decomposition of NO_2 gas in to NO and O is the initial reaction of the formation of photochemical smog.
    3. $NO_{2_{(g)}}$ undergoes photolysis by absorbing the sunlight.
    4. Photo chemical smog is a yellow colour hazy fumes that reduces the visibility.
    5. O_3 of photochemical smog reduces the quality of rubber and fabric materials.

27. Which of the following statements is false regarding the electrolysis of an aqueous solution of $CuSO_4$ using inert electrode.
    1. The blue colour of the solution is changed.
    2. The mass of the cathode is increasing.
    3. It is impossible to form Cu^+ however.
    4. It is possible to evolve H_2 gas at the cathode.
    5. It can be evolved O_2 gas at the anode.

28.  Consider the polymer can be formed using this compound as the repeating unit. Which of the following statements is true regarding that polymer.
    1. H is a thermosetting polymer.
    2. The repeating unit of that polymer is 
    3. This polymer becomes hard and rigid, once it is moulded and can not be soft by heating.
    4. It is a condensation polymer.
    5. The polymer is cross linked in order to from a 3D structure.

29. Select the unexpectable compound to form when $dil\ NaOH$ is added to a mixture of CH_3CH_2CHO and CH_3CHO .

(1). 
(2.) 
(3.) 
(4). 
(5.) 

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

  (1) If only (a) and (b) are correct.
  (2) If only (b) and (c) are correct.
  (3) If only (c) and (d) are correct.
  (4) If only (d) and (a) are correct.
  (5) If any other number or combination of responses is correct.

  Summary of above Instructions,

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

30. When the liquids P and Q are mixed to from a solution, the temperature decreased slightly. which is / are true regarding this ?
    a) The resultant solution shows a negative deviation to Roults law.
    b) When CH_3COCH_3 and $CHCl_3$ are mixed the above observation can be occurred.
    c) Here the Phenomenon of inter molecular forces is are $f_{P-P} > f_{P-Q}$, $f_{Q-Q} > f_{P-Q}$
    d) When P and Q are mixed volume expansion can be occurred than the total of the initial volumes.

31. Which of the following statement/s is / are true?
    a) The exothermic reactions with a negative entropy is spontaneous in law – temperatures.
    b) The endothermic reactions with a negative entropy is spontaneous in high temperatures.
    c) The exothermic reactions with a positive entropy is non-spontaneous in law temperatures.
    d) The endothermic reactions with a positive entropy is spontaneous in high temperatures.

32. $CH_3 - CHBr - CHBr - C_2H_5 \xrightarrow[KOH]{\text{alcoholic}} \underset{(A)}{CH_3 - C \equiv C - CH_3} + \underset{(B)}{CH_2 = CH - CH = CH_2}$

    Which of the following statement/s is / are true regarding the above reaction.
    a) The products of the above reaction is A and B only.
    b) The main product of the reaction is A.
    c) If the medium is aqueous instead of been alcoholic, the above reaction yields $\text{pentane} - 2,3 - \text{diol}$
    d) SP hybridized carbon atoms can be seen only in one compound of the products formed here.

33. Which is / are true regarding the manufacture of soap?
    (a) In manufacture of soap esters undergo basic hydrolysis.
    (b) Glycerol is obtained as a sub product of soap.
    (c) The base which is used in manufacture of baby soap is KOH.
    (d) In manufacture of soap acetic acid is used to neutralize the unreacted excess base.

34. Which of the following statement / s is / are incorrect regarding the rate of a reaction?
    (a) When the size of the particles of the solid reactants is decreasing the rate of the reaction is decreasing
    (b) When the pressure is increasing in gaseous reactions the rate of the reaction is increasing.
    (c) When a catalysts is used the reaction changes its path which is having a low activation energy and increases the rate of the reaction.
    (d) When the temperature of an exothermic reaction is increasing then the rate of the reaction is decreasing.

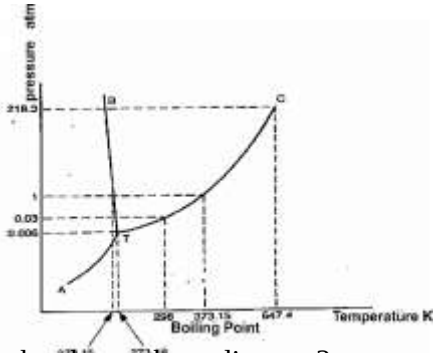
35. In the reaction between $CH_2 = CH_2$ and Br_2 / CCl_4 What is / are the possible step / s can be occurred.

(a). $CH_2 = CH_2$ (Br, Br) (b). $^{+}CH_2CH_2Br$ (c). $CH_3 - \underset{\displaystyle Br}{\underset{|}{CH_2}}$ (d). $CH_2 - CH_2 + \ddot{\underset{\displaystyle +}{Br}}$ (Br)

36. Which is / are true regarding the compounds with lattice structures,
    (a) Chemical properties depend on the bonding nature arouse in the formation of a lattice.
    (b) Homogeneous and heterogeneous lattice structures are created by the covalent bonding among the atoms.
    (c) Ionic lattices are formed by the strong static electric attractions arouse between negative and positive ions.
    (d) When the materials with ionic lattices are fused it conducts electricity due to the existence of mobile electrons.

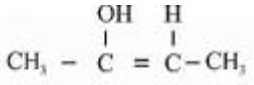
37. The equilibrium constant of the following reaction at 298 K is 9.
At 298 K $A\,(g) + \;B\,(g) \;\rightleftharpoons\; C\,(g) + \;D\;(g)$
At 298 K one mole each of the gases A and B are mixed in a closed rigid vessel. After a certain period of time 0.6 mol of $C(g)$ has formed. Which of the following statements is/ are true regarding this system.
(a) This system is in the equilibrium.
(b) In this system there is 0.4 moles of A(g) in the equilibrium.
(c) This system has not reached the equilibrium.
(d) The forward reaction occurs more to reach the equilibrium.

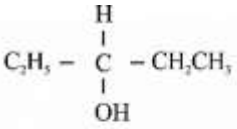
38. The phase diagram of H_2O is given below.

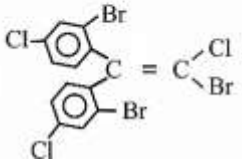


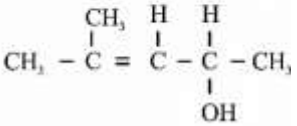
Which of the following statements is / are true regarding the above phase diagram?
(a) When the pressure of a water sample which exists under 347.15K and 2 atm pressure reduces to 0.001 atm liquid water converts to water vapours.
(b) At the point T, the three species of H_2O, ice liquid H_2O and water vapour are in equilibrium.
(c) At higher temperatures than 647.4 K , It is impossible to convert water vapours to liquid water by applying a high pressure.
(d) AT curve shows the relevant temperature and pressure to exist liquid water and water vapour in equilibrium.

39. Select the compound / s which is / are showing the stereoisomerism.

(a). 

(b). 

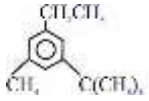
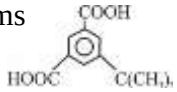
(c). 

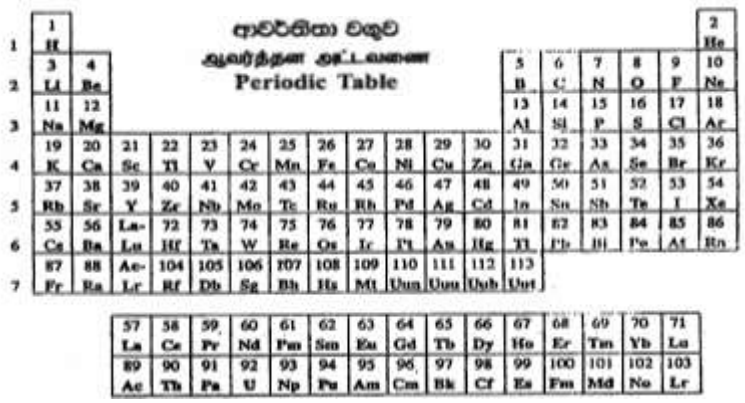
(d). 

40. Which of the following statement /s is / are true regarding the main cycles ?
(a) The photosynthesis is the only way of fixation of carbon in an eco - system.
(b) In the absence of decomposition bacteria, carbon in dead plants and animals can accumulate as fossil fuels.
(c) Water molecule are breaking by photolysis and give usable oxygen.
(d) Denitrifying bacteria converts nitrates to atmospheric nitrogen again.

- **In question numbers 41 to 50, two statements are given in respect of each question. From the table given below, select the response out of the responses (1), (2), (3), (4) and (5) that best fits the two statements and mark appropriately on your answer sheet.**

1st Statement	2nd Statement	Response
True	True and 1st statement is explained correctly	1
True	True and 1st statement is not explained correctly	2
True	False	3
False	True	4
False	False	5

	1st Statement	2nd Statement
41.	In $XeOF_2$ the elecron geometry around the central atom Xe, is Octahedral.	In $XeOF_2$ there are 6 VESPR pairs around the central atom Xe.
42.	 oxides with $H^+/\ KMnO_4$ and forms 	Under the conditions of which primary and secondary alkyl groups oxidise, tertiary alkyl groups do not oxidise.
43.	$N_2(g) + \ 3\ H_2(g) \ \rightleftharpoons \ \ 2\ NH_3(g), \Delta H < 0$ By increasing the temperature and the pressure, of this reaction NH_3 Production can be increased.	When the temperature is increasing the rates of the forward and the reverse reactions are increasing.
44.	Zn^{2+} does not form any complex with ammonia.	Zn is not a transition element.
45.	Amines are more basic than alcohols.	The stability of an alkyl oxonium ion relative to to an alcohol is higher than the stability of an alkyl ammonium ion relative to an amine.
46.	CO_2 dissolves more in warm water than the cold water.	Water solubility of a gas is an exothermic reaction.
47.	To show the bleaching action of $Ca(OCl)_2$ the moisture should be present.	When moisture is present then $Cl_2\,(g)$ is liberated by $Ca(OCl)_2$
48.	Propanoic acid and Methyl ethanoate are two functional group isomers.	Both propanoic acid and Methyl enthanoate have the same molecular formula.
49.	In acid medium it is impossible to distinguish between SO_2 and H_2S gases by $K_2Cr_2O_7$	In acidic medium orange colour $K_2Cr_2O_7$ reduces to yellow colour K_2CrO_4
50.	CO_2 gas consists of non-polar molecules.	There are dispersion forces in solid CO_2 (dry ice)



වයඹ පළාත් අධ්‍යාපන දෙපාර්තමේන්තුව

Provincial Department of Education - NWP

02 | E | II

Second Term Test - Grade 13- 2018

Index No : .....

Chemistry II

Three Hours

- **Periodic Table is provided.**
- **Use of calculations is not allowed.**

❖ **Part A - Structures Essay**

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

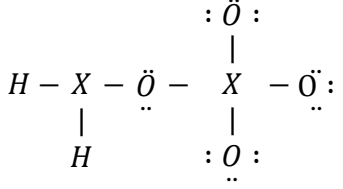
❖ **Part B and Part C - Essay**

- **Answer four questions selecting two questions from each part. Use the paper supplied for this purpose.**

Part A - Structured Essay

Answer all four questions on this paper itself. (Each question carries 10 marks)

(01) (a) The Skeletal structure of the anion $H_2\ X_2\ O_4{}^{2-}$ is given below. The element X belongs to P black.



(i) If the charges are there for the atoms, mention those charges on the atoms of the above structure.

(ii) By considering the structure with minimum charges as the most stable one, draw the most acceptable Lewis structure for the above ion.

(iii) Identify the element X, if the atomic number of X is smaller than 18

……

(iv) Considering the structure drawn in above (ii) Fill in the table

Property	**X atom bonded to both H atoms**	**Central O atom**	**X atom bonded to four O atoms.**
(a) Number of VSEPR pairs			
(b) Electron pair geometry			
(c) Hybridization			
(d) Basic shape			

(v) For the above anion draw the other possible structures except the drawn Structure in part (ii) Mention the stability of them.

(b) Arrange the followings according to the ascending order of the given property inside the brackets.

i. $H_2O_{(S)}$, $CO_{2_{(S)}}$ and $SiO_{2_{(S)}}$ (melting point)

.....<.....<.....

ii. $CH_3CH_2CH_2CH_2OH$, $CH_3CH_2CH_2CH_2NH_2$ and C_2H_5COOH (boiling point)

.....<.....<.....

iii. H_2O , C_2H_5OH , NH_3 and C_2H_2 (acidity)

.....<.....<..... <.....

iv. F^- , OH^- , NH_2^- and CH_3^- (basicity)

.....<.....<..... <.....

v. Mg^{2+} , N^{3-} , Na^+ , F^- and O^{2-} (ionic radius)

.....<.....<..... <.....<.....

vi. $AlCl_3$, $NaCl$ and $MgCl_2$ (ability of hydrolysis)

.....<.....<.....

(02) (a) The element M belongs to the third period. It gives H_2 by reacting with dil. H_2SO_4. When M reacts with con. H_2SO_4 it gives a gas which shows bleaching properties. The sulphate of M is used in purification of drinking water. When M is combusted in air, both oxide and the nitride are formed.

(i) Identify the metal M .....

(ii) Write the balance equation for the reaction of M and conc. H_2SO_4

.....

(iii) What is the oxidation state of M shown in the compounds?

.....

(iv) Although N_2 is inert when M is combusted in air, N_2 reacts with it. Explain the reasons.

.....

.....

(v) Write a use of the chloride of M.

.....

(b) The aqueous solution of the following compounds are provided in the vessels labelled from A to E.

$BaCl_2(aq)$, $Na_2S_2O_3(aq)$, $Pb\,(NO_3)_2\,(aq)$, $Mn\,Cl_2(aq), Zn\,(NO_3)_2\,(aq)$

To distinguish the above compounds, carried out tests and their observations are given in the following table.

Solution	Addition of aqueous $NaOH$	Addition of aqueous H_2SO_4
A	A clear solution	A gas is evolved and the solution is not clear.
B	A clear solution	A white precipitate is obtained
C	A white precipitate	A clear solution is obtained.
D	White precipitate is obtained and it turns to black within a short period of time.	A clear solution is obtained
E	A white precipitate is obtained.	A white precipitate is obtained

(i) Identify the solution A to E.

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

(ii) Write the balance equations for the reactions relevant to each of the above observations.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(c) X and Y are two elements of the second period of the periodic table. The electron affinities of them are positive values. The first ionization energy of X is less than the first ionization energy of Y.

(i) Identify the elements.

$X =$ $Y =$

(ii) Write the electron configuration of an excited atom of X.

.....

(iii) When X is combusted in air it reacts with Y. Write the chemical equation for the reaction using the chemical symbols.

.....

(iv) Write the balanced chemical equations for the reactions taken place when the followings react with the oxide of X.

1. dil. HCl .....
2. aqueous $NaOH$ .....

(v) Write the balance equation for a suitable reaction to prepare a sample of the element Y in the laboratory.

.....

(vi) Write two uses of the element Y.

.....

.....

(03) (a) Consider the following data at 298 K

Standard lattice enthalpy of $LiCl\ (s)$	= -848 kJ mol^{-1}
Standard lattice enthalpy of $NaCl\ (s)$	= -776 kJ mol^{-1}
Standard enthalpy of hydration of $Li^+\ (g)$	= -499 kJ mol^{-1}
Standard enthalpy of hydration $Na^+\ (g)$	= -390 kJ mol^{-1}
Standard enthalpy of hydration $Cl^-\ (g)$	= -381 kJ mol^{-1}

(i) Define the standard lattice enthalpy.

.....

.....

.....

(ii) Standard lattice enthalpy of LiCl is more exothermic than NaCl. What is the reason for that?

.....

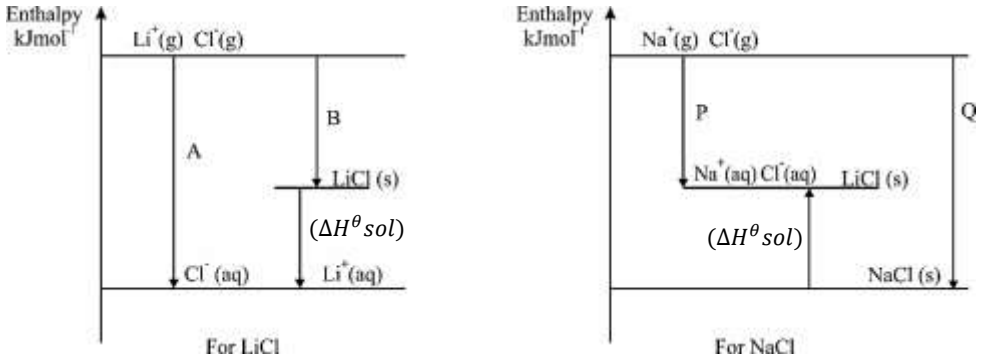
.....

(iii) For an ionic compound what is the relationship among the lattice enthalpy $(\Delta H^{\theta}{}_{L})$ hydration enthalpies $(\Delta H^{\theta}{}_{hyd})$ of ions and enthalpy of dissolution $(\Delta H^{\theta}{}_{dissolution})$

.....

.....

(iv) The enthalpy diagrams, relevant to the above two ionic compounds are given below.



Mention the relevant values for A, B, P and Q given in the above enthalpy diagrams.

A ..... B .....

P ..... Q .....

(v) Calculate the standard enthalpy of dissolution $(\Delta H^{\theta}{}_{dissolution})$ of $LiCl\ (s)$

.....

.....

.....

(vi) Calculate the standard enthalpy of dissolution $(\Delta H^{\theta}{}_{dissolution})$ of $NaCl\ (cs)$

(b) At 400^0C $HI(g)$ partially decomposes as follows.

$2\,HI\ (g) \rightleftharpoons H_2(g) + I_2\ (g)$

At 400^0C for the decompose reaction of HI the initial rates are measured relevant to the initial concentration of HI(g) as follows.

Initial $[HI](moldm^{-3})$	1.67	3.34	5.01	6.68
Initial rate $(mol\ dm^{-3}S^{-1})$	0.41	1.64	3.69	6.56

(i) write the rate expression for the decompose reaction of $HI\ (g)$ by giving reasons.

.....

(ii) At 400 ^0C the activation energy of the forward reaction is 184 $kJ\ mol^{-1}$ and the activation energy for the backward reaction is 163 $kJ\ mol^{-1}$ Draw the diagram for the variation of energy versus the reaction co ordinate for the above reaction. Mark the activation energy of it.

(iii) Calculate the enthalpy change of the decompose reaction of $HI\ (g)$.

.....

.....

.....

(iv) How does the increasing of temperature affect for the decomposition of $HI\ (g)$? Explain by giving reasons.

.....

.....

(v) At that temperature when the reaction is allowed to take place in the presence of the catalyst the activation energy of the reverse reaction is 85 $kJ\ mol^{-1}$. Calculate the value of the activation energy of the forward reaction.

.....

.....

.....

(C) Conc. HNO_3 reacts with iodine (I_2) to yield HIO_3, NO_2 and H_2O Derive the balanced chemical equation for the reaction.

.....

.....

.....

.....

.....

(04) (a) The empirical formula of the organic compound B is C_2H_4O and it is an ester. The r.m.m. of it is about 87.5.

(i) What is the molecular formula of B?

.....

(ii) The esters W, X, Y and Z are structural isomers of B. Draw the structures of them.

W	X
Y	Z

(iii) Starting with $CH_3\,Br$, Show how you would synthesize a sample of the above compound "A". The number of steps should not exceed six.

(iv) When the above B undergoes acidic hydrolysis, the resultant alcohol is C. C reacts with acidified $K_2Cr_2O_7$ to give the product D. D forms a yellowish orange precipitate with $2{,}4-DNP$. But D does not react with $NH_4OH\ +\ AgNO_3$.

1. What is the functional group should exist in D, to react with $2,4-\ DNP$

   .....

2. Why does not D react with $NH_4OH\ +\ AgNO_3$

   .....

3. Write the structural formula of C and its $IUPAC$ name.

   .....

4. What is the structure of B, among W, X, Y and Z.

   .....

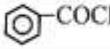
   .....

(b) (i) Draw the structure of the main products obtained when the following reactions are taken place Mention the reaction type as,

Nucleophilic Addition (A_N) Electrophilic Addition (A_E)

Nucleophilic Substitution (S_N) Electrophilic Substitution (S_E)

Elimination (E)

Number	Reactant	Reagent	Main Product	
1	C_6H_5OH	$Br_2(l)$		
2	CH_3CH_2COCl	CH_3NH_2		
3	CH_2= CH -CH_2Cl	aqueous NaOH		
4		RMgX		
5	CH_3CH_2OH	PCl_5		
6	$CH_3CH = CH_2$	HBr		

(ii) Write the mechanism of the reaction relevant to the (3) above.

(C) (i) Starting with methanol, show how you would synthesize a sample of $Ethane-1,2-diol$ (ethylene glycol) The number of steps should not exceed five.

(iv) Write a use of $Ethane-1,2-diol$

Third Term Test - 2018

Chemisty 2018 - PART B – Grade 13

- **Answer two question only (Each question carries 15 mark)**

(05) (a) One mole of $N_2(g)$ and three moles of $PCl_3\,(g)$ were placed in a closed vessel and the temperature was increased up to 500K. The system was allowed to reach the following equilibrium.

$PCl_5\,(g) \quad \rightleftharpoons \quad PCl_3(g) \; + \; Cl_2\,(g)$

The total pressure of the equilibrium system was 2.08×10^5 Pa . By assuming the ideal behaviour of the relevant gases under the given conditions, answer the following questions.

(i) Calculate the total number of moles in the equilibrium system.

(ii) Calculate the number of moles of $PCl_5(g)$, $PCl_3(g)$, $Cl_2(g)$ and $N_2\,(g)$ in the equilibrium system.

(iii) Calculate the partial pressures of the above four gases in the equilibrium system.

(iv) Hence calculate K_p for the system.

(v) Using the calculated value of K_p in part (iv) above. Calculate the value of K_c

(vi) Under the same conditions, if the above equilibrium system is formed, without adding N_2 gas at the beginning, calculate the partial pressures of $PCl_5(g)$, and $PCl_3(g)$, $Cl_2(g)$ the total pressure.

(vii) When the system is reached the equilibrium without N_2 does the value of K_p change or not ? Explain your answer.

(b) Standard hydrogen electrode is the recommended reference electrode to measure the potential of a simple electrode. But it is inconvenient to use the standard hydrogen electrode practically. So silver - silver chloride electrode is the commonly used practical reference electrode.

(i) When Zn metal is dipped in an aqueous solution of Zn^{2+}, how does the electric potential create ?

(ii) Why is it impossible to measure the absolute electrode potential, shown in part (i) above ?

(iii) What are the standard conditions should be used in the formation of the standard hydrogen electrode?

(iv) Silver – silver chloride electrode can be used to measure the potential of a simple electrode. Draw a labelled diagram of the silver - silver chloride electrode.

(v) What are the advantages of using silver - sliver chloride electrode as a reference electrode?

(vi) Silver - silver chloride electrode is used to measure the electrode potential of a Zn electrode prepared by a student in the laboratory. The value obtained is - 0.91 V

$E^e \;\; Zn^{2+}_{aq} \;/\; Zn\;(s) \;\; = \;\; -0.76\,V$

$E^e\, Ag \;/\; AgCl \qquad = \; +0.23\;V$

(A) Write the cell notation for the cell when silver – solver chloride electrode is connected with Zn electrode.

(B) How do you explain the obtaining - 0.91 V for the electrode potential.

(06) (a) (i) The ionic solid $Ba\,(IO_3)_{2(S)}$ is sparingly soluble in water. Derive an expression for the solubility product of $Ba(IO_3)_2$

(ii) Calculate the maximum mass of $Ba\,(IO_3)_2$ can be dissolved in 50 cm^3 of pure water.
The molar mass of $Ba\,(IO_3)_2$ = 487 $gmol^{-1}$
$K_{SP} \qquad = \; 1.08 \times 10^{-7} mol^3 dm^{-9}$

(iii) Calculate the molar solubility of $Ba\,(IO_3)_{2(s)}$ in the aqueous solution of 0.02 $mol\;dm^{-3}$ $Ba\,(NO_3)_2$.

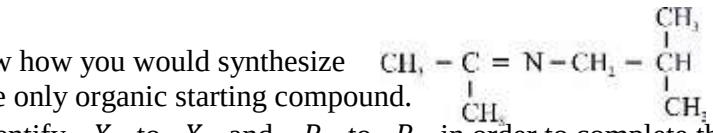
(iv) A solution mixture is prepared by adding $200\ cm^3$ of $0.01\ mol\ dm^{-3}$ $Ba(NO_3)_2\ (s)$ and $100\ cm^3$ of $0.1\ mol\ dm^{-3}$ $Na\ (IO_3)_{(S)}$ solutions together. Calculate the molar solubility of $Ba(IO_3)_{2\ (S)}$ in the above solution mixture.

(b) (i) BOH is a weak base. By considering the initial concetration of $BOH\ (aq)$ as C and the degree of dissociation of the weak base as α, derive an expression for the dissociation constant of the base K_b

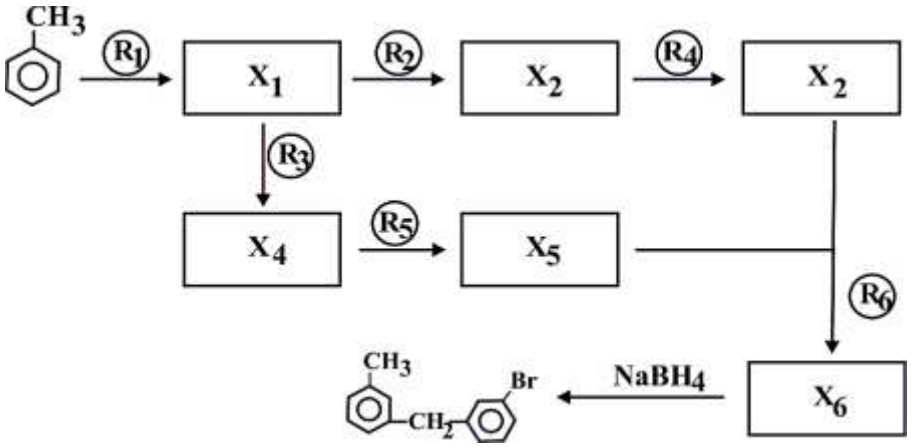
(ii) Calculate the pH value of $0.1\ mol\ dm^{-3}$ $BOH\ (aq)$ solution
$K_b = 1.0 \times 10^{-5}\ mol\ dm^{-3}$

(iii) Calculate the pH value of the solution mixture prepared by mixing $100\ cm^3$ of $0.1\ mol\ dm^{-3}$ BOH and $100\ cm^3$ of $0.01\ mol\ dm^{-3}$ HCl Solutions.
$kw = 1.0\ x\ 10^{-14}\ mol^2\ dm^{-6}$

(c) The mixture of A and B shows ideal behaviour. At 400K equi-molar mixture of A and B undergoes fractional distillation. The resultant solution also undergoes the fractional distillation. Calculate the mole fraction of A in the final distillate.
At 400 K $P^0\ A = 40\ KPa$
$P^0\ B = 50\ KPa$

(07) (a) (i) Show how you would synthesize  using $CH_3CH(Cl)CH_3$ as the only organic starting compound.

(ii) Identify X_1 to X_6 and R_1 to R_6 in order to complete the following reaction scheme.



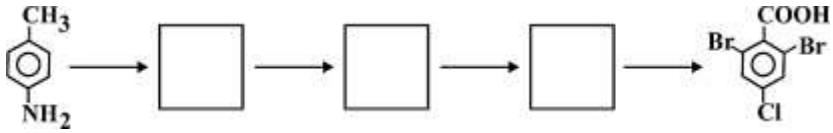
(b) Explain the reasons for the followings.

(i) $CH_3CH_2NH_2$ is more basic than CH_3CONH_2

(ii) The boiling point of CH_3CH_2OH is greater than that of CH_3OCH_3

(c) (i.) A mixture is prepared by dissolving aniline and phenol in ether. How to distinguish between aniline and phenol.

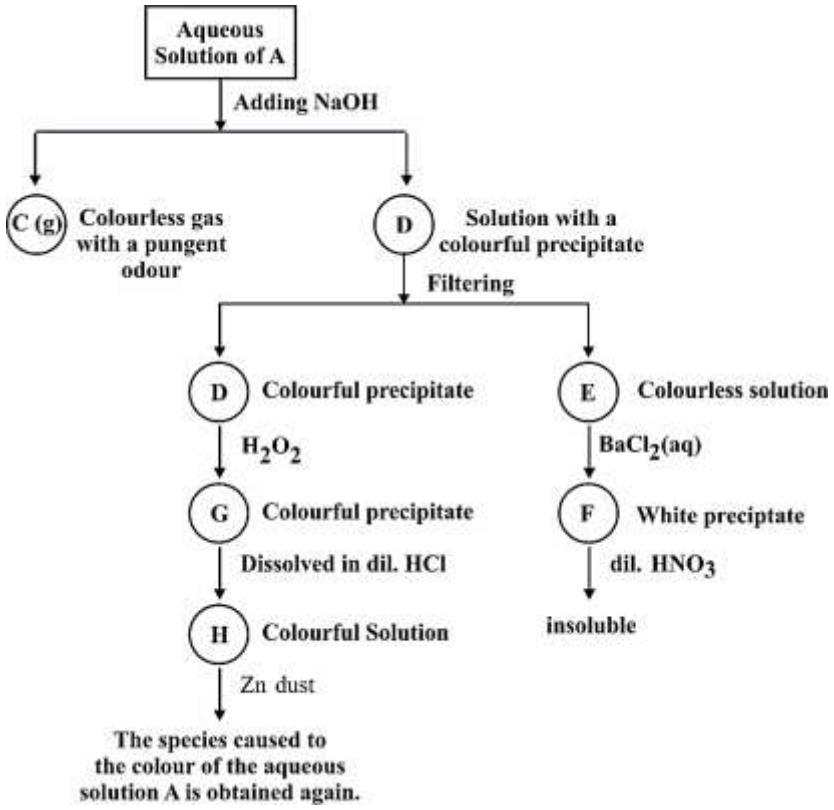
(i) Complete the following conversion.



Part - C ESSAY

- **Answer two question only (Each question carries 15 marks)**

(08) (a) The compound A contains two salts which are formed by combining an anion with two different cations. The aqueous solution of A light green in colour. The tests carried out for the aqueous solution of A and their observations are given below.



(i) Write the chemical formula of the species caused to the colour of the aqueous solution of A.Write the IUPAC name of it.

(ii) Write the chemical formula of the precipitates D, G and F

(iii) What is the gas C.

(iv) Write the balanced equation for the reaction occured when Zn dust is added to the solution H.

(v) Write the chemical formulae of the two salts contain in A.

(b) An aqueous solution consists of $Cu^{2+}\ (aq)$ and $C_2O_4^{2-}\ (aq)$. The following experiment is carried out to determine the molar ratio of $Cu^{2+}\ (aq)$ and $C_2O_4^{2-}\ (aq)$ in the given solution.

First the aqueous solution is acidified by dil. H_2SO_4. The volume of $22.6\ cm^3$ of $0.02\ mol\ dm^{-3}\ KMnO_4$ is required for complete oxidation of the $C_2O_4^{2-}\ (aq)$ ions of the above solution. The resultant solution is neutralized by adding $Na_2CO_3\ (aq)$ solution.

Then the solution is acidified by the acetic acid and excess KI is added. To reduce the liberated I_2 from it, $11.3\ cm^3$ of $0.05\ mol\ dm^{-3}\ Na_2S_2O_3\ (aq)$ is required.

(i) Write balanced equations for all reactions could be taken place here.

(ii) Calculate the molar ratio of the ions $Cu^{2+} : C_2O_4^{2-}\ (aq)$ consisting in the solution.

(c) Write the balanced equations for the reactions taking place with the followings.

i. $Cl_{2\ (g)}$ with excess $NH_{3\ (g)}$

ii. $S_{(S)}$ with aqueous $NaOH$

iii. Excess $H_2S_{(g)}$ with aqueous $NaOH$

iv. H_2O_2 and PbS

(09) (a) The following questions are based on the extraction of iron by blast furnace method.

(i) Name two iron ore used as raw materials.

(ii) Limestone and coke are also used as raw materials. Mention the purpose of using them in the process.

(iii) Write the balanced equation for the reactions takenplace at the higher temperatures than $1000^0\ C$ in the blast furnance.

(iv) At the higher temperatures the reaction $2\ CO\ (g)\ +\ O_2(g)\ \longrightarrow\ 2\ CO_2(g)$ is not taking place. Explain the reasons for the above fact.

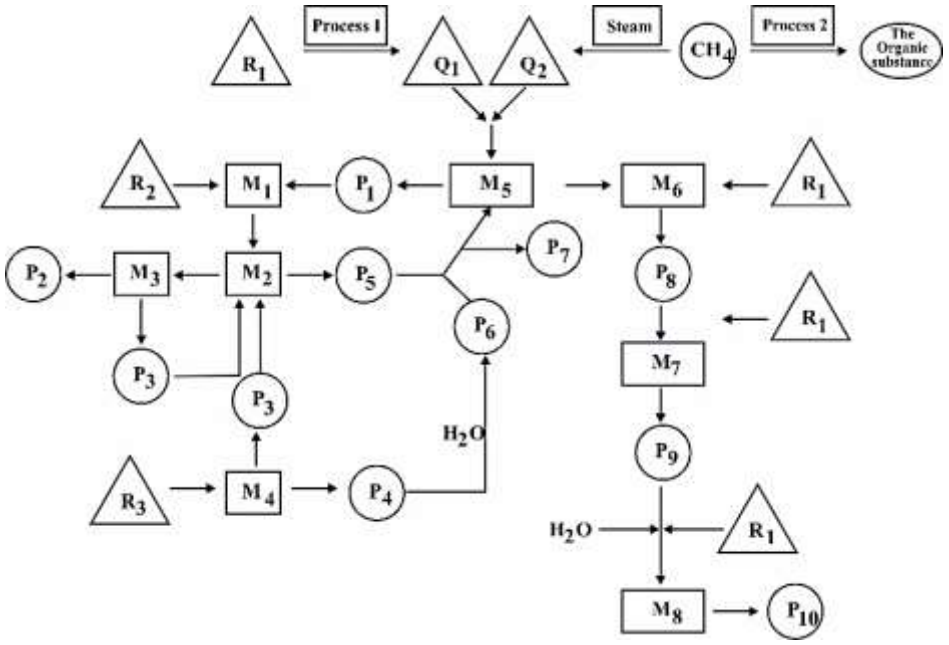
(v) Write the balanced equations for the reactions taken place inside the blast furnance at the temperatures lower than $1000^0\ C$

(vi) What is the function of slag in the iron extraction ?

(vii) 'Iron corrosion' taken place in the neutral medium is an electrochemical process,

1. Write the balanced equation for the reaction at the anode.
2. Write the balanced equation for the reaction at the cathode,
3. Write the balanced equation for the cell reaction occurred in the corrosion.

(b)



Here, $R_1\ ,R_2\ ,R_3$ are natural raw materials Q_1 and Q_2 are the raw materials required in the production of M_5

$M_1\ ,M_2\ ,M_3,\ M_4\ ,M_5\ ,M_6,\ M_7\ ,$ and M_8 are the manufacturing processes.

$P_1\ ,P_2\ ,P_3,\ P_4\ ,P_5\ ,P_6,\ P_7\ ,P_8\ ,P_9\ ,\ P_{10}$ are the products obtained.

(i) Name the $R_1\ ,R_2\ ,R_3$ natural raw materials.

(ii) Identify the raw materials given as Q_1 and Q_2

(iii) Identify the process I and process II.

(iv) Identify the processes M_1 to M_8

(v) What are the products obtained as P_1 to P_{10}

(vi) Write the balanced equations for the reactions taken place in each of $M_1\ ,M_2\ ,M_3,\ M_4\ ,M_5\ ,M_6,\ M_7\ ,M_8$ manufacturing processes.

(vii) Write one use each of P_1 and P_{10} products.

(10) (a) A few compounds which can be used as repeating units in polymer industry is given below.

$$HCHO,\ CH_2 = CHCl\ ,\ CH_2 = \overset{CH_3}{\overset{|}{C}} - \ CH = \ CH_2\ ,\ C_6H_5OH$$

$$C_6H_5CH = \ CH_2\ ,\qquad H_2N - (CH_2)_5 - \ COCl\ \ ,\ CF_2 = \ CF_2$$

Considering only the naturally synthesized polymers and the polymers can be formed by using the above Compounds as the repeating units, answer the following questions.

(i) What is the thermoplastic polymer which can withstand high temperatures?
(ii) What is the additional polymer which is having a weak elasticity.
(iii) What is the linear polymer of the condensation type ?
(iv) What is the thermosetting polymer ?
(v) What is the condensation polymer which is having a three dimensional structure.?
(vi) What is the addition polymer which does not catch fire easily ?
(vii) Draw the structures of the polymers those you have mentioned in (i), (ii) and (iii) above.

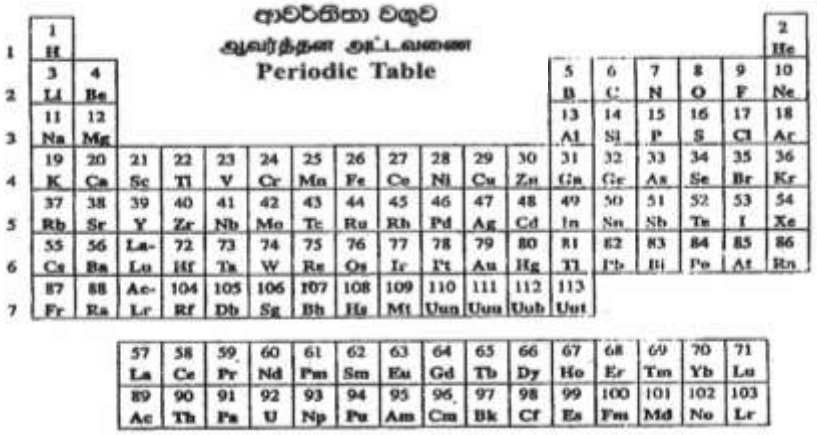
(b) The various types of plastics which are using in our day to day life, are made up of polymers.
(i) Mention three environmental problems of using plastics.
(ii) Suggest three methods to reduce the environmental pollution occurred due to the plastic usage.
(iii) What are the substances which involve in the formation of photo chemical smog. What are the favourable conditions for the formation of photo chemical smog ?
(iv) Explain the adverse effects of photochemical smog towards the man and plants.
(v) The substances which affect for the depletion of ozone layer known as the depleting agent. What is the major depleting agent in ozone layer depletion? How does it form?
(vi) Write the equations for the reaction of ozone dissociation by the major contributor, mentioned in part (v) above.
(viii) Write two environmental problems can arise due to ozone layer depletion.

(c) The following data were obtained, in an experiment carried out to determine the distribution coefficient of ethanoic acid (CH_3COOH)among butanol and water at 298K.

- The volume of $NaOH$ required to react completely with $25cm^3$ of the water layer was $5.0cm^3$
- To react completely with $10cm^3$ of the butanol layer $40cm^3$ of the same $NaOH$ solution was required

i. Calculate the distribution coefficient of CH_3COOH among H_2O and butanol at 298K.

ii. At 298K, $50cm^3$ of $0.05moldm^{-3}$ CH_3COOH (aq) acid solution was mixed with $25cm^3$ of butanol and shaken vigorously. Then the mixture was kept to reach the equilibrium. $20cm^3$ of a aqueous layer the equilibrium mixture was separated and titrated with $0.20moldm^{-3}$ $NaOH$ solution. Calculate the reacted volume of $NaOH$, at the end point.



Third Term Test Grade 13 - 2018
Chemistry Answer - Script Part A - Structured Essay

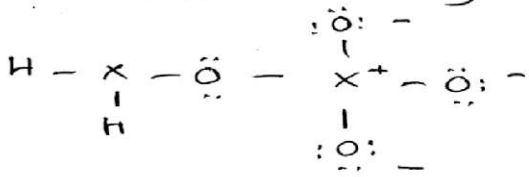
Part I

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

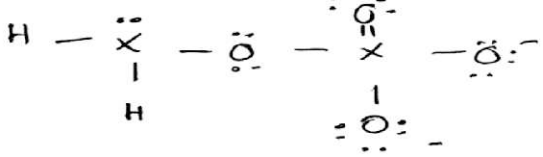
Part II

Structured Essay

(01) (i)



(ii)



04 marks.

12 marks.

(iii)

X = P

06 marks.

ii. Ammonium carbonate.

iv. CO_2 and NH_3

b). i. $CO_2 < H_2O < SiO_2$.

ii. $CH_3CH_2CH_2NH_2 < CH_3CH_2CH_2CH_2OH < C_2H_5COOH$

iii. $NH_3 < C_2H_2 < C_2H_5OH < H_2O$

iv. $F^- < OH^- < NH_2^- < CH_3^-$

v. $Mg^{2+} < Na^+ < F^- < O^{2-} < N^{3-}$

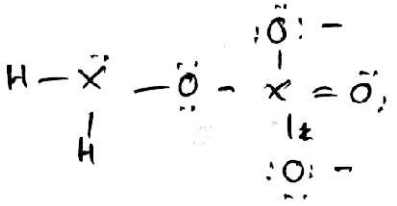
vi. $NaCl < MgCl_2 < AlCl_3$

05 x 6 = 30 marks.

(iv)

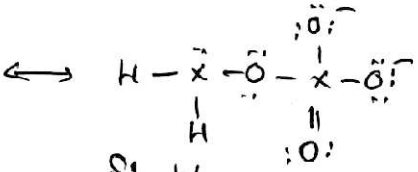
a	4	4	4
b	tetrahedral	tetrahedral	tetrahedral
c	sp^3	sp^3	sp^3
d	trigonal pyramidal	angular	tetrahedral

(v) 02x12 = 24 marks.



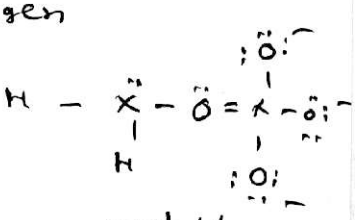
Stable.

(-) charge on more electronegative oxygen.



Stable.

(-) charge on oxygen



unstable.

* charge distribution is high
* + charge on oxygen.

For Structures 05x3 = 15 marks.

Stability 03x3 = 09 marks

24

(2) (a) i. M = Al. (07 marks)

ii. $2Al + 6H_2SO_4 \longrightarrow Al_2(SO_4)_3 + 3SO_2 + 6H_2O$

iii. +3 (03 marks) (05 marks)

iv. $Al + O_2 \longrightarrow Al_2O_3$ this is (formation of Al_2O_3) is highly exothermic. ✓ Due to the released heat here, dissociation of $N \equiv N$ is easy. ✓ (06 marks)

v. use as a catalyst in organic chemistry. (02 marks)

(b) i. A = $Na_2S_2O_3$

B = $BaCl_2$

C = $Zn(NO_3)_2$

D = $MnCl_2$

E = $Pb(NO_3)_2$ (04 × 5 = 20 marks)

ii. $Na_2S_2O_3 + H_2SO_4 \longrightarrow Na_2SO_4 + SO_2 + S + H_2O$

$BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + 2HCl$

$Zn(NO_3)_2 + 2NaOH \longrightarrow Zn(OH)_2 + 2NaNO_3$

$MnCl_2 + 2NaOH \longrightarrow Mn(OH)_2 + 2NaCl$

$Pb(NO_3)_2 + 2NaOH \longrightarrow Pb(OH)_2 + 2NaNO_3$

$Pb(NO_3)_2 + H_2SO_4 \longrightarrow PbSO_4 + 2HNO_3$

(04 × 6 = 24 marks)

(c) i. X = Be Y = N (04 × 2 = 08 marks)

ii. $1s^2 2s^1 2p^1$ (04 marks)

iii. $3Be + N_2 \longrightarrow Be_3N_2$ (04 marks)

iv. $2HCl + BeO \longrightarrow BeCl_2 + H_2O$

$2NaOH + BeO \longrightarrow Na_2BeO_2 + H_2O$ (04 × 2 = 08 marks)

$NH_4NO_2 \xrightarrow{\Delta} N_2 + 2H_2O$ or

$(NH_4)_2Cr_2O_7 \longrightarrow N_2 + Cr_2O_3 + 4H_2O$ (05 marks)

vi. *. NH_3 production.

*. Filling tyres.

*. liquid N_2 as a rocket fuel (02x2 = 04 marks)

(03) (a) i. The change in enthalpy that takes place when one mole of an ionic compound in the solid state is formed from gaseous positive ions and negative ions at the standard state. (05 marks)

ii * ionic radius of Li^+ is smaller than that of Na^+

* anions in both are the same. (Cl^-)

*. inter-ionic distance in LiCl lattice is short. Therefore bond among the ions of LiCl lattice strength is high. (02x4 = 08 marks)

iii. $\Delta H^\theta_{sol} = \Delta H^\theta_{hyd} - \Delta H^\theta_L$ (05 marks)

iv. A = -880 Kjmol^{-1}

B = -848 Kjmol^{-1}

P = -771 Kjmol^{-1}

Q = -776 Kjmol^{-1} (02x4 = 08 marks)

v. ΔH^θ_{sol} of $LiCl_{(s)}$ = $-880 - (-848)$ Kjmol^{-1}

= -32 Kjmol^{-1} // ✓ (05x2 = 10 marks)

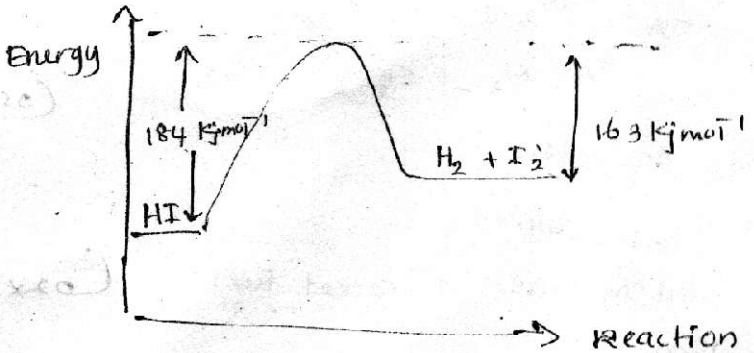
ΔH^θ_{sol} of $NaCl_{(s)}$ = $-771 - (-776)$ Kjmol^{-1}

= $+5$ Kjmol^{-1} // (05x2 = 10 marks)

(b). When the concentration of HI is doubled (from 1.67 moldm^3 to 3.34 moldm^3). The initial rate 0.41 is increased upto 1.64, i.e increased by ~~forti~~ four times. Therefore the order w.r.t HI is two. ✓

$\therefore R = K[HI]^2$. ✓ (05x2 = 10 marks)

II



III. $\Delta H = (184 - 163)\ Kjmol^{-1}$ (02×6 = 12 marks)

$= +21\ Kjmol^{-1}$

IV. (05 marks)

* Decomposition of HI is endothermic ✓
* When temperature is increased, forward reaction is ~~more~~ favourable (shifts to right) according to the Le chatelliers' priaciple. ✓
* Therfore the decomposition is high ✓

(03×3 = 09 marks)

V. ΔH = Activation Energy of forward reaction − Activation Energy of the backward reaction (reverse) ✓

∴ Activation energy of the forward reaction = ΔH + ac. En. of reverse reaction

$= 21 + 85 = 106\ Kjmol^{-1}$ //

(05×2 = 10 marks)

(c)

$10\ HNO_3 + I_2 \longrightarrow 2HIO_3 + 10NO_2 + 4H_2O$ (04 marks)

$6\ H_2O + I_2 \longrightarrow 2IO_3^- + 12H^+ + 10e$. (02 marks)

$e + 2H^+ + NO_3^- \rightarrow NO_2 + H_2O$ (02 marks)

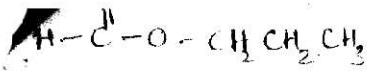
04 (a) i. $n = \dfrac{r.m.m.}{\text{mass of the empirical formula}}$.

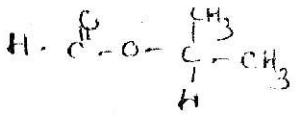
$= \dfrac{87.5}{44} \simeq 2$ ✓

II molecular formula $= C_4H_8O_2$ //

✓

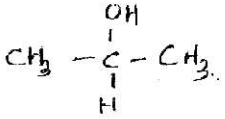
(06 marks)

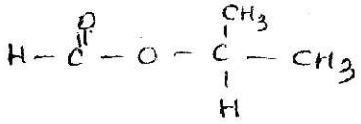




iii. 1. carbonyl group. (03 x 4 = 12 marks)

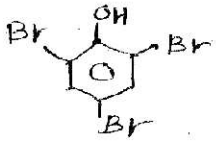
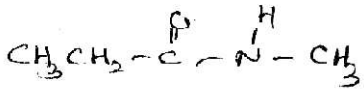
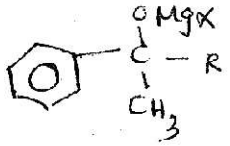
2. absence of $-CHO$

3. propan-2-ol 

4. 

(03 x 5 = 15 marks)

(b)

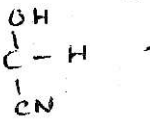
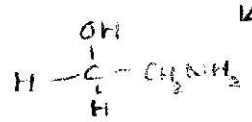
	Main product	Reaction type.
1.		S_E
2.		S_N
3.	$CH_2 = CH - CH_2 - OH$	S'_N
4.		A_N
5.	CH_3CH_2Cl	S_N
6.	$CH_3 - \underset{Br}{CH} - CH_3$	A_E

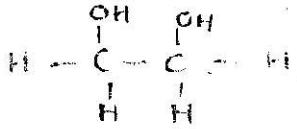
02 x 12 = 24 marks

ii. $CH_2 = CH - CH_2 - Cl \longrightarrow CH_2 = CH - \overset{+}{C}H_2 + Cl^-$

$CH_2 = CH - \overset{+}{C}H_2 \; :OH^- \longrightarrow CH_2 = CH - CH_2 - OH$

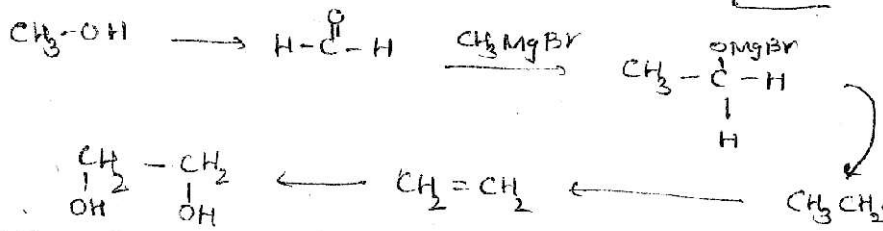
(02 x 6 = 12 marks)

(c) i. $CH_3OH \xrightarrow{PCC} HCOH \xrightarrow{HCN}$  $\xrightarrow[2.\ H_2O]{1.\ LiAlH_4}$ 

$\xleftarrow{NaNO_2 + HCl}$ 

5

ii. [illegible] OR



(02×7 = 14 marks)

(5) (i) By assuming the ideal behaviour of the gases (02)

$PV = nRT$

$n = \frac{PV}{RT} = \frac{2.08 \times 10^5 Nm^{-2} \times 100 \times 10^{-3} m^3}{8.314 \, JmoT^{-1}K^{-1} \times 500 K}$ (04+1)

$= 5 mol$

(ii) $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ (02+1) 10

	$PCl_5(g)$	$PCl_3(g)$	$Cl_2(g)$
Initial moles	3	–	–
moles at Equilibrium	3−x	x	x

(05)

Total moles $= 3 + x + 1 = 5 mol$

$x = 1 mol$ (02)

$n_{PCl_5} = 2 mol$

$n_{PCl_3} = 1 mol$

$n_{Cl_2} = 1 mol$

$n_{N_2} = 1 mol$

02×4 = (08) 15

(iii) $P_{PCl_5(g)} = \frac{2}{5} \times 2.08 \times 10^5 Nm^{-2}$

$= 0.832 \times 10^5 Nm^{-2}$

$P_{PCl_3(g)} = \frac{1}{5} \times 2.08 \times 10^5 Nm^{-2}$

$= 0.416 \times 10^5 Nm^{-2}$

$P_{Cl_2(g)} = \frac{1}{5} \times 2.08 \times 10^5 Nm^{-2} = 0.416 \times 10^5 Nm^{-2}$

$P_{N_2} = 0.416 \times 10^5 \ Nm^{-2}$ (03x4 = 12) 5

12

iv. $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$

$K_p = \dfrac{P_{PCl_3(g)} \times P_{Cl_2(g)}}{P_{PCl_5(g)}}$ (05)

$= \dfrac{0.416 \times 10^5 \ Nm^{-2} \times 0.416 \times 10^5 \ Nm^{-2}}{0.832 \times 10^5 \ Nm^{-2}}$ (04 to)

$= 2.08 \times 10^4 \ Nm^{-2}$ // (04 + 01)

15

(v). $K_p = K_c (RT)^{\Delta n}$ (03)

$= K_c (RT)^{2-1}$ (02) $= K_c (RT)$

$K_c = \dfrac{K_p}{RT} = \dfrac{2.08 \times 10^4 \ Nm^{-2}}{8.314 \ J mol^{-1} K^{-1} \times 500 K}$ (05)

$= 5 \ mol m^{-3}$ (03)

13

(vi) Partial pressures do not change.

$P_{PCl_5(g)} = 8.32 \times 10^4 \ Nm^{-2}$

$P_{Cl_2} = P_{PCl_3(g)} = 4.16 \times 10^4 \ Nm^{-2}$

$P_T = (8.32 + 4.16 \times 2) \times 10^4$

$= 1.664 \times 10^5 \ Nm^{-2}$ (02x3 = 06 marks)

04

10

(vii).

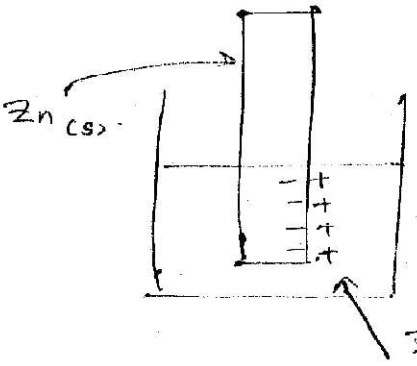
The value of K_p does not change.

K_p depends only on the temperature

05

5a - 80

(b) i.



The following reaction is established.

$$Zn_{(s)} \rightleftharpoons Zn^{2+}_{(aq)} + 2e.$$

Metal ions are released to the solution, by oxidizing the metal. As a result electrons are collected on the surface of the metal and positive ions are aggregated in the solution around the metal, so a bilayer is formed and a potential difference is arised

(03×4 = 12 marks)

ii. In the instrument, used to measure the potential difference, another metal should be connected to the other terminal. Thus the potential difference is measured between the two metals. Therefore it is a relative potential (not an absolute potential)

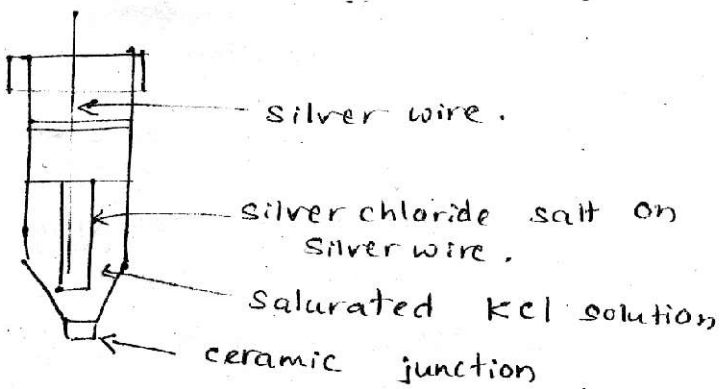
(05 marks)

iii.

* $[H^+_{(aq)}] = 1 mol\,dm^{-3}$
* Pressure of $H_{2(g)} = 1 atm$
* Temperature = 25 °C
* Allow to react on the metal surface of the Pt (s)

(01×4 = 04 marks)

(iv)



v. * does not need a salt bridge. (10 marks)
* low cost to prepare.
* does not evolve any gases so no need to control the pressure.
* easy to handle.
* should not be controlled the concentration of the electrolyte.
(02 x 5 = 10 marks)

(vi). Expected electromotive force $= E^{\theta}_{Ca} - E^{\theta}_{An}$ (03)

$= 0.23\ V - (-0.76)\ V$ (03)

$= 0.99\ V$ (04)

(A). $Zn_{(s)} / Zn^{2+}_{(aq)(1\ mol\ dm^{-3})} \| Cl^{-}_{(aq)(saturated)} / AgCl_{(s)} / Ag_{(s)}$ (15)

(B) $[Zn^{2+}_{(aq)}]$ is not $1\ mol\ dm^{-3}$ ✓

Temperature is not 25°C ✓

Due to the personal errors can be occurred in obtaining the readings. 02 x 2 = 04 (marks)

06 (i) $Ba(IO_3)_{2(s)} \rightleftharpoons Ba^{2+}_{(aq)} + 2IO_3^{-}{}_{(aq)}$ b - 70 (02)

$K_c = \dfrac{[Ba^{2+}_{(aq)}][IO_3^{-}{}_{(aq)}]^2}{[Ba(IO_3)_{2(aq)}]}$ (03)

$K_c [Ba(IO_3)_{2(s)}] = [Ba^{2+}_{(aq)}][IO_3^{-}{}_{(aq)}]^2$ (03)

concentration of a solid is a cons

$\therefore K_{sp} = [Ba^{2+}_{(aq)}][IO_3^-{}_{(aq)}]$ (02)

(05)

(ii) By considering the solubility of $Ba(IO_3)_{2(s)}$ in water as x mol dm^{-3}. [15]

$Ba(IO_3)_{2(s)} \rightleftharpoons Ba^{2+}_{(aq)} + 2IO_3^-{}_{(aq)}$

$x \qquad 2x$

$K_{sp} = [Ba^{2+}_{(aq)}][IO_3^-{}_{(aq)}]^2$ (03)

(03)

$= 4x^3$

$x = \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{1.08 \times 10^{-7}\ mol^3 dm^{-9}}$

$= 3 \times 10^{-3}$ mol dm^{-3} // (02)

number of moles in 50 cm^3 $= 3 \times 10^{-3} \times \frac{50}{1000}\ cm^3 = 0.15 \times 10^{-3}$ mol (02)

mass of $Ba(IO_3)_2$ soluble $= \underbrace{3 \times 10^{-3} \times \frac{50}{1000}}_{0.15 \times 10^{-3} mol} \times 487\ g\,mol^{-1}$ (03)

$= 0.07305$ g

$= 73.05$ mg (01)

(iii) By considering the molar solubility of $Ba(IO_3)_2$ in $Ba(NO_3)_2$ as y,

$Ba(NO_3)_{2(aq)} \rightarrow Ba^{2+}_{(aq)} + 2NO_3^-{}_{(aq)}$

$0.02\ mol\,dm^{-3}$

$Ba(IO_3)_{2(s)} \rightleftharpoons Ba^{2+}_{(aq)} + 2IO_3^-{}_{(aq)}$ ✓

$0.02+y \qquad 2y$

$0.02+y \simeq 0.02$ mol dm^{-3} ✓

$K_{sp} = [Ba^{2+}_{(aq)}][IO_3^-{}_{(aq)}]^2$ ✓

$1.08 \times 10^{-7}\ mol^3 dm^{-9} = 0.02\ mol\,dm^{-3} \times (2y)^2$ ✓

$y^2 = \frac{1.08 \times 10^{-7}\ mol^3 dm^{-9}}{0.02\ mol\,dm^{-3} \times 4}$ ✓

$y = 0.0864 \times 10^{-7}\ mol^2 dm^{-6}$

$y = 8.64 \times 10^{-9}$ mol dm^{-3} ✓

02 x 6 = 12

(iv) The concentration IO_3^-, $[IO_3^-]$ in the initial solution.

$Ba(NO_3)_{2\,(aq)} + 2NaIO_{3\,(aq)} \longrightarrow Ba(IO_3)_{2\,(s)} + 2NaNO_{3\,(aq)}$

$n_{Ba(NO_3)_2} = \frac{0.01 \times 200}{1000}$

$= 2 \times 10^{-3}$ mol ✓

Initial $n_{NaIO_{3\,(aq)}} = \frac{0.1 \times 100}{1000}$ mol

$= \underline{\underline{1 \times 10^{-2}}}$ mol $= 10 \times 10^{-3}$ mol ✓

$NaIO_3$ reacted $= n_{Ba(NO_3)_2} \times 2$

unreacted IO_3^- $= 1 \times 10^{-2}$ mol $- 2 \times 2 \times 10^{-3}$

$\left(NaIO_{3\,(aq)} \longrightarrow Na^+_{(aq)} + IO_{3\,(aq)}^- \right)$ $= (10 \times 10^{-3} - 4 \times 10^{-6})$ mol ✓

$= 6 \times 10^{-3}$ mol ✓

$[IO_{3\,(aq)}^-] = \frac{6 \times 10^{-3}\,\text{mol} \times 1000\,cm^3}{300\,cm^3}$

$= \underline{\underline{2 \times 10^{-2}}}$ mol dm^{-3} ✓

if the solubility of $Ba(IO_3)_2$ is z mol dm^{-3}

$Ba(IO_3)_{2\,(s)} \rightleftharpoons Ba^{2+}_{(aq)} + 2IO_{3\,(aq)}^-$

assuming z is too small, $(2z + 0.02) \approx 0.02$ mol dm^{-3} ✓

$K_{sp} = [Ba^{2+}_{(aq)}][IO_{3\,(aq)}^-]^2$ ✓

1.57×10^{-9} mol^3 dm^{-9} $= z \times (0.02\ \text{mol dm}^{-3})^2$

$z = \frac{1.08 \times 10^{-7}\ \text{mol}^3\text{dm}^{-9}}{(2 \times 10^{-2}\ \text{mol dm}^{-3})^2}$ ✓

$= 0.27 \times 10^{-3}$ mol dm^{-3} ✓

(b). $BOH_{(aq)} \rightleftharpoons B^+_{(aq)} + OH^-_{(aq)}$ $(03 \times 10 = 30\ \text{marks})$

1	–	–	(O_3)
$1-\alpha$	α	α	
$c(1-\alpha)$	$c\alpha$	$c\alpha$	(O_2)

$$K_b = \frac{[B^+_{(aq)}][OH^-_{(aq)}]}{[BOH_{(aq)}]} \quad (03)$$

$$= \frac{c\alpha - c\alpha}{c(1-\alpha)} = \frac{c\alpha^2}{(1-\alpha)} \quad (02)$$

By assuming α is too small, $1-\alpha \simeq 1$

$\therefore K_b = c\alpha^2$ (05)

(ii). $BOH_{(aq)} \rightleftharpoons B^+_{(aq)} + OH^-_{(aq)}$

$c(1-\alpha)$ $\quad c\alpha \quad c\alpha$

$[OH^-] = c\alpha$ (04)

$K_b = c\alpha^2$

$\alpha = \sqrt{\frac{K_b}{c}}$ (02) $= \frac{1\times10^{-5}}{0.1}$

$= 1\times10^{-2}$ (02)

$[OH^-_{(aq)}] = 0.1\ mol dm^{-3} \times 1\times10^{-2}$

$= 1\times10^{-3}\ mol dm^{-3}$ (02)

$pOH = -\log [OH^-_{(aq)}]$ (03)

$= 3$

$pH = 14 - 3$

$= 11$ (02)

Assumption: The temperature of the solution is 25°C

15

(iii). $BOH_{(aq)} + HCl_{(aq)} \longrightarrow BCl_{(aq)} + H_2O_{(l)}$ (05)

$n_{BOH\ (initial)} = 0.1\ mol dm^{-3} \times 0.1 dm^3$

$= 0.01\ mol$ (02)

$n_{HCl} = 0.01\ mol dm^{-3} \times 0.1 dm^3$

$= 0.001\ mol$ (02)

Unreacted $n_{BOH} = (0.01 - 0.001)\ mol$

$= 0.009\ mol$ (02)

$[BOH_{(aq)}]$ at equilibrium $= \frac{0.009\ mol}{0.2\ dm^3}$

$= 0.045\ mol dm^{-3}$ (02)

$[BCl_{3\ (aq)}]$ at equilibrium $= \frac{0.001\ mol}{0.2\ dm^{-3}}$

$= 5\times10^{-3}\ mol dm^{-3}$ $= 0.005\ mol dm^{-3}$ (02)

(ob) (c). $P_A = P_A^\circ X_A$ ✓

$= 40 \text{ kpa} \times 0.5 = 20 \text{ kpa}$ ✓

$P_B = P_B^\circ X_B$ ✓

$= 50 \text{ kpa} \times 0.5 = 25 \text{ kpa}$ ✓

In the vapour of the first distillate,

mole fraction of A is y_A

mole fraction of B is y_B ✓

total pressure is P_T.

By assuming the vapour is ideal, ✓

$P_A = P_T \times y_A$ ✓

$20 \text{ kpa} = P_T y_A \quad -①$ ✓

$P_B = P_T \times y_B$ ✓

$25 \text{ kpa} = P_T \times y_B \quad -②$ ✓

In the vapour of the second distillate,

the mole fraction of A is y_A'

the mole fraction of B is y_B'

total pressure is P_T ✓

$P_A = 40 \text{ kpa} \times 4 = 160 \text{ kpa}$ ✓

$P_B = 50 \text{ kpa} \times 5 = 250 \text{ kpa}$ ✓

$P_A = P_T y_A'$ ✓

$160 \text{ kpa} = P_T y_A' \quad -①$ ✓

$P_B = P_T Y'_B$

$250\ kpa = P_T \cdot Y'_B$ — (2) ✓

(1)/(2) $\quad \frac{160}{250} = \frac{Y'_A}{Y'_B} = \frac{16}{25}$ ✓

∴ mole fraction of A : B in the second distillate $= 16 : 25$

∴ the mole fraction of A $= \frac{16}{41}$ //

$0.1 \times 20 = 20$ moles

C → 20

A buffer solution obtained so,

$$p^{OH} = p^{K_b} + \log_{10} \frac{[BCl_3]}{[BOH]} \quad (0.5)$$

$$= -\log 1\times10^{-5} + \log_{10} \frac{[BCl]}{[BOH]}$$

$$= -\log 1\times10^{-5} + \log \frac{5\times10^{-3}}{4.5\times10^{-2}}$$

$$= 5 + \log \frac{5}{45}$$

$$= 5 + \log 1/9$$

$$= 5 + \log 0.1111$$

$$= 5 + T.0458 = 4.0458 \quad (0.5)$$

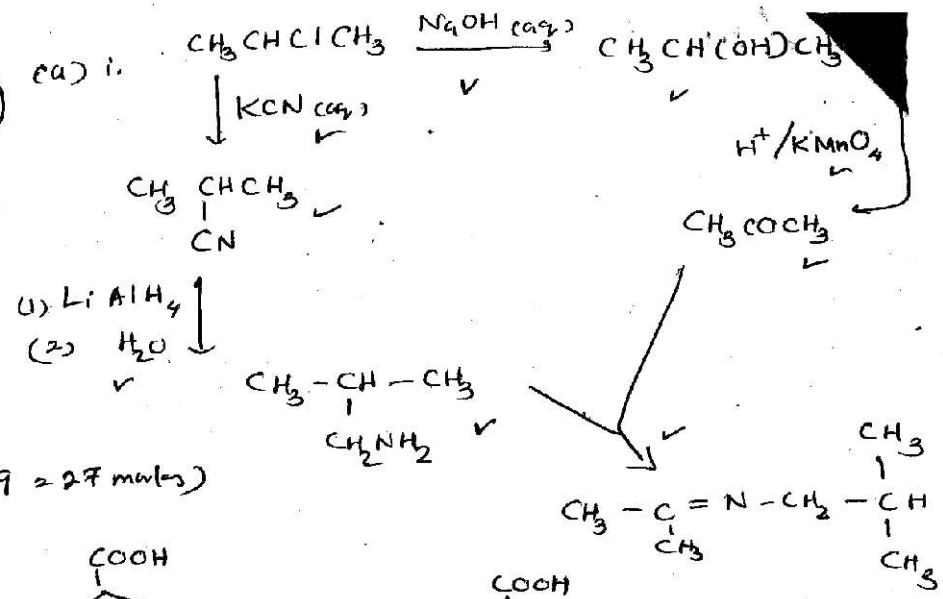
$$pH = 14 - 0.0458$$

$$= 9.95 \text{ //} \quad (0.5)$$

b → 60

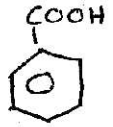
30

07 (a) i.

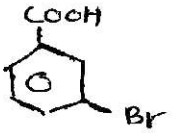


(03×9 = 27 marks)

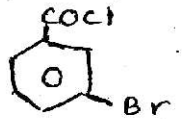
(ii). X_1 =



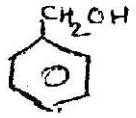
X_2 =



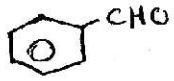
X_3 =



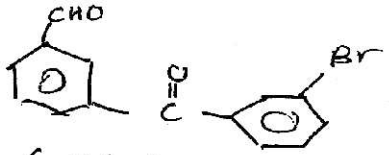
X_4 =



X_5 =



X_6 =



(06×6 = 36 marks)

R_1 = $H^+ / KMnO_4$

R_2 = $FeCl_3 / Br_2$

R_3 = $LiAlH_4 / H_2O$

R_4 = PCl_5 or PCl_3

R_5 = PCC

R_6 = anhy $AlCl_3$

(02×7 = 14 marks)

(b)

i. 09 marks.

ii. 09 marks.

(c) (i) * When NaOH is added to the mixture phenol is entered to the aqueous layer.

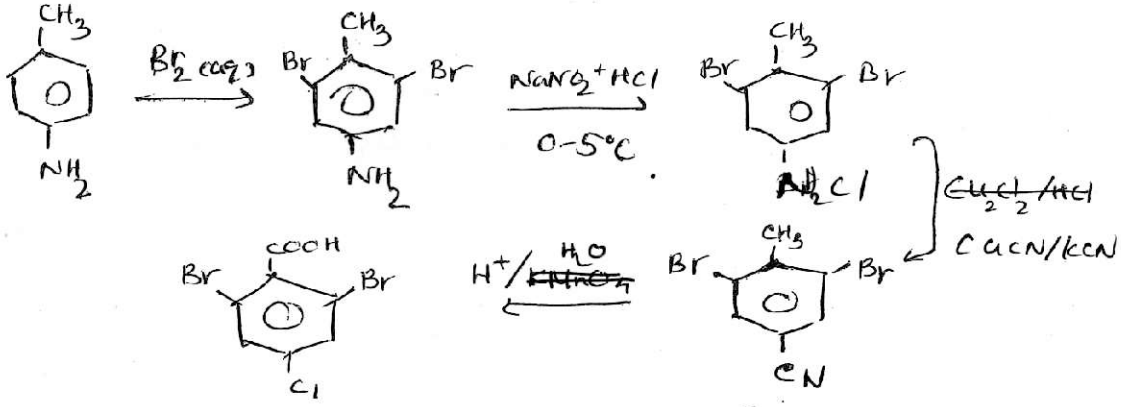
* Later, the aqueous layer is seperated by ether. When an acid is added to it,  can be seperated.

(ii) * When dil HCl is added to the mixture aniline is entered to the aqueous layer.

* Then, the aqueous layer is seperated by ether. When NaOH is added to it,  can be seperated.

(05 x 4 = 20 marks)

(ii).



(05 x 7 mals = 35)

(08) (a) i. $[Fe(H_2O)_6]^{2+}$ (10) Hexaaquairon(II) ion (05)

ii. D = $Fe(OH)_2$ G = $Fe(OH)_3$ F = $BaSO_4$
(05 x 3 = 15 marks)

iii. C = NH_3 (10)

iv. $2Fe^{3+}_{(aq)} + Zn \longrightarrow 2Fe^{2+}_{(aq)} + Zn^{2+}_{(aq)}$ (10)

v. $FeSO_4(NH_4)_2SO_4$ (10)

60

(c). i. $3Cl_2 + 8NH_3 \longrightarrow N_2 + 6NH_4Cl$

ii. $4S + 6NaOH \longrightarrow 2Na_2S + Na_2S_2O_3 + 3$

iii. $H_2S + NaOH \longrightarrow NaHS + H_2O$

iv. $4H_2O_2 + PbS \longrightarrow PbSO_4 + 4H_2O$ $10 \times 4 = 40$ C → 40

(09) (a). i. Hematite, Magnetite, Siderite, Limonite
Iron pyrites (02 × 2 = 04 marks)

ii. functions of limestones :- $CaCO_3$ decomposes to CaO and CO_2 gas. CaO reacts with silicate impurities SiO_2 and Al_2O_3 and removes [forms slag ($CaSiO_3$) and $Ca(AlO_2)_2$]

functions of coke :- * coke burns producing heat ~~which is~~ required for the furnance.

* converts formed $CO_2 \longrightarrow CO$

* FeO is directly reduced by CO and C (02 × 4 = 08 marks)

iii At high temperature C Above 1000 °C

$C + O_2 \longrightarrow CO_2$ ✓

$CO_2 + C \longrightarrow 2CO$ ✓

$CaO + Al_2O_3 \longrightarrow Ca(AlO_2)_2$ ✓

$CaO + SiO_2 \longrightarrow CaSiO_3$ ✓

$FeO + C \longrightarrow Fe + CO_2$ ✓

(03 × 5 = 15 marks)

iv. For the reaction, $2CO_{(g)} + O_{2(g)} \longrightarrow 2CO_{2(g)}$,

$\Delta H = (-)$

$\Delta S = (-)$ ✓ ✓

According to $\Delta G = \Delta H - T\Delta S$ ✓

at a high temperature, (−)ve value of $T\Delta S$ is greater ✓

Therefore $\Delta G = (+)$ ve ✓

∴ At high temperatures the reaction is not favourable (not occurred) ✓

(02 × 6 = 12 marks)

v. $CaCO_3 \longrightarrow CaO + CO_2$

$3Fe_2O_3 + CO \longrightarrow 2Fe_3O_4 + CO_2$

$Fe_3O_4 + CO \longrightarrow 3FeO + CO_2$

$FeO + CO \longrightarrow Fe + CO_2$. (05×4 = 20 marks)

vi. The density of slag is lower than that of molten iron, so slag floats on molten iron (into the bottom). Slag protects iron from oxidising by the air which is blown in the bottom (05 marks)

vii. 1. $Fe_{(s)} \longrightarrow Fe^{2+}_{(aq)} + 2e$. (05)

2. $O_{2(g)} + 2H_2O_{(l)} + 4e \longrightarrow 4OH^-_{(aq)}$ (05)

3. $2Fe_{(s)} + O_{2(g)} + 2H_2O_{(l)} \longrightarrow 2Fe^{2+}_{(aq)} + 4OH^-_{(aq)}$ (06)

a-80

(b). i. R_1 = air. ✓

R_2 = brine solution. ✓

R_3 = lime stone. ✓

ii. $Q_1 = N_{2(g)}$ ✓ $Q_2 = H_{2(g)}$. ✓

iii. process - I - fractional distillation of liquid air. ✓

process - II - anaerobic decomposition. ✓

iv. M_1 - reaction of brine solution with NH_3 ✓

M_2 - reaction of ammoniated brine with CO_2 ✓

M_3 - decomposition of $NaHCO_3$ ✓

M_4 - roast the limestone. ✓

M_5 - production of NH_3 / Haber process. ✓

M_6 - oxidation of NH_3 by air ✓

M_7 - oxidation of $NO_{(g)}$ by air ✓

M_8 - Manufacture of HNO_3. ✓

v. $P_1 = NH_3$ ✓ $P_2 = Na_2CO_3$ ✓ $P_3 = CO_2$ ✓

$P_4 = CaO$ ✓ $P_5 = NH_4Cl$ ✓ $P_6 = Ca$ ✓

$P_7 = CaCl_2$ ✓ $P_8 = NO$ ✓ $P_9 = NO_2$ ✓

$P_{10} = HNO_3$ ✓ (02×25 = 50)

vi. In M_1 ⇒ $NH_3 + H_2O \rightleftharpoons NH_4OH$ ✓

In M_2 ⇒ $OH^- + CO_2 \rightleftharpoons HCO_3^-$ ✓

$HCO_3^-(aq) + Na^+(aq) \longrightarrow NaHCO_3(s)$ ✓

OR

$NaCl + CO_2 + H_2O + NH_3 \longrightarrow NaHCO_3 + NH_4Cl$

In M_3 ⇒ $2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$ ✓

In M_4 ⇒ $CaCO_3 \rightarrow CaO + C_2$ ✓

In M_5 ⇒ $N_2 + 3H_2 \rightleftharpoons 2NH_3$. ✓

In M_6 ⇒ $4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$ ✓

In M_7 ⇒ $2NO + C_2 \longrightarrow 2NO_2$ ✓

In M_8 ⇒ $4NO_2 + 2H_2O + O_2 \rightarrow 4HNO_3$. ✓

vii. $P_2 = Na_2CO_3$

Manufacture of glass
softening of Hard water.
Manufacture of soap
Manufacture of detergents.

$P_{10} = HNO_3$

used in explosives
used in the synthesis of NH_4NO_3
for use as a fertilizers

for ~~adan~~ uses → (02) (02×9 = 18 marks)

b - To

(a) i. Teflon :

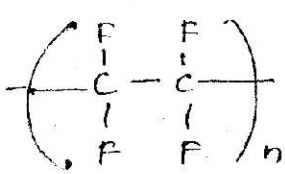
ii. Natural rubber.

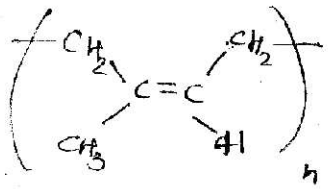
iii. Nylon -6

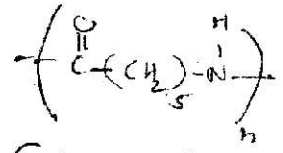
iv. phenol formaldehyde (Bakelite)

v. phenol formaldehyde

vi. P.V.C.

vii. 





a - 45

(05 x 9 = 45 marks)

(b). i. * Since plastics are not degradible easily, when they are dumping in open area, threat of mosquitoes can be spread.

* when plastics are burning in oper area the toxic gases such as furan, dioxan are added to the atmosphere.

* when plastics are dumping in the ground the toxic metals such as Pb, Hg are added to the groundwater.

* The water drays (drainage system of cities) of roads are blocked by the light plastics and caused in floods in rainy season

* when food waste in dumps are eaten by animals the plastic wrappers, lunch sheets etc cause in harmful effects towards the health of animals sometimes death.

(03 x 3 = 09 marks)

ii. * Avoiding the burning plastics in open areas.

* Avoiding the dumping of plastic materials to the ground.

* recycling

* minimizing the un-reusable (unrecyclable) plastics.

* using biodegradible plastics.

* Implementation of the rules and regulations.
Ex; manufacture of plastics with lower densities than 20 μm is banned.

(03 x 3 = 09 marks)

iii. - NO_x, unburnt hydrocarbons. (02 x 2 = 04 marks)

Favourable conditions :- * light (sunlight) * temperature greater than 15°C

iv. Man - * eye irritations (02 x 2 = 04 marks)
* disturb the vision
* respiratory problems such as coughing asthma.

Plants - * Sunlight is blocked by the smog. it disturbs the photosynthesis
* decrease the growth rate of the plants. reduce the yield
* Substances of the smog is toxic to the plants. (02 x 5 = 10 marks)

v. *. Chlorine free radicals ($Cl^\cdot$) (02)

*. ~~CFC~~ decompose the compounds of CFC.

Ex: $F-\underset{\underset{Cl}{|}}{\overset{\overset{F}{|}}{C}}-F \xrightarrow{h\nu} C\dot{F}_2Cl + Cl^\cdot$ (05)

vi.

$Cl^\cdot + O_3 \longrightarrow ClO^\cdot + O_2$ ✓

$O_2 \xrightarrow{h\nu} 2O$ ✓

$ClO^\cdot + O \longrightarrow O_2 + Cl^\cdot$ ✓

overall reaction : $2O_3 \longrightarrow 3O_2$ ✓

vii. * Causes to skin cancers. (02 x 4 = 08 marks)

* cataract formation

* weakened the immunity system of man.

*. destruction of the fish population in water bodies.

* Increase the rate of degradation of the materials such as rubber and plastics.

(02 x 2 = 04 marks)

b - 55

(e) $16H^+ + 2MnO_4^- + 5C_2O_4^{2-} \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$ (10)

8 (b) $2Cu^{2+} + 2I^- \longrightarrow 2Cu^+ + I_2$ (05)

$I_2 + 2S_2O_3^{2-} \longrightarrow 2I^- + S_4O_6^{2-}$ (05)

$n_{MnO_4^-} = 0.02 mol dm^{-3} \times 22.6 \times 10^{-3} dm^3 = 45.2 \times 10^{-5} mol$ ✓

$n_{C_2O_4^{2-}} = n_{MnO_4^-} \times \frac{5}{2} = 0.02 mol dm^{-3} \times 22.6 \times 10^{-3} dm^3 \times \frac{5}{2}$

$= 1.13 \times 10^{-3} mol.$

$= 113 \times 10^{-5} mol$ ✓

$n_{Cu^{2+}} = n_{S_2O_3^{2-}}$

$= 0.05 mol dm^{-3} \times 11.3 \times 10^{-3} dm^3$

$= 0.565 \times 10^{-3} mol.$ ✓ $n_{I_2} = 0.2825 \times 10^{-3} mol$ ✓

$n_{Cu^{2+}} = 0.2825 \times 10^{-3} \times 2 = 0.565 \times 10^{-3} mol$

$n_{C_2O_4^{2-}} : n_{Cu^{2+}}$

$1.13 \times 10^{-3} : 0.565 \times 10^{-3}$ $(56.5 \times 10^{-5} : 113.0 \times 10^{-5})$

2 : 1 ✓

05 × 6 = 30

b - 50

10 (c) $CH_3COOH + NaOH \longrightarrow CH_3COO^-Na^+ + H_2O$ ✓

$n_{NaOH} = x mol dm^{-3} \times 5 \times 10^{-3} dm^3 = 5x \times 10^{-3} mol$ ✓

$n_{CH_3COOH} = 5x \times 10^{-3} mol$

$[CH_3COOH]_{(aq)} = \frac{5x \times 10^{-3} mol}{25 \times 10^{-3} dm^3} = \frac{x}{5} mol dm^{-3}$ ✓

By considering the ~~when~~ the titration of the butanol & lager,

$n_{NaOH} = x mol dm^{-3} \times 40 \times 10^{-3} dm^3$

$= 40x \times 10^{-3} mol$ ✓

$n_{CH_3COOH} = 40x \times 10^{-3} mol$ ✓

~~boundary~~

$\therefore [CH_3COO]_{butanol} = \frac{40x \times 10^{-3} \text{ mol}}{10 \times 10^{-3} \text{ dm}^3} = 4x \text{ mol dm}^{-3}$ ✓

$K_D = \frac{[CH_3COOH]_{aq}}{[CH_3COOH]_{butanol}}$ ✓

$= \frac{x/5 \text{ mol dm}^{-3}}{4x \text{ mol dm}^{-3}} \cdot \frac{1}{20}$ // ✓

(ii) Initially

n_{CH_3COOH} in aqueous layer

$= 0.05 \text{ mol dm}^{-3} \times 50 \times 10^{-3} \text{ dm}^3$ ✓

$= 250 \times 10^{-5} \text{ mol}$

At the equilibrium, if the number of moles of CH_3COOH gone to butanol layer is x,

the remaining n_{CH_3COOH} in aqueous layer $= (250 \times 10^{-5} - x)$ ✓

$[CH_3COOH]_{butanol} = \frac{n \times 1000}{25} = 40x \text{ mol dm}^{-3}$ ✓

$= \frac{(250 \times 10^{-5} - x)\, 10^3}{50} = 20(250 \times 10^{-5} - x) \text{ mol dm}^{-3}$

$\frac{1}{20} = \frac{20(250 \times 10^{-5} - x)}{40x}$ ✓

$x = 6 \times 10^{-5}$ ✓

n_{CH_3COOH} in aqueous layer $= 250 \times 10^{-5} - 6 \times 10^{-5} = 2.44 \times 10^{-3} \text{ mol}$ ✓

n_{CH_3COOH} in $20 \text{ cm}^3 = \frac{2.44 \times 10^{-3} \times 20}{50} = 9.76 \times 10^{-4} \text{ mol}$ ✓

n_{NaOH} required $= 9.76 \times 10^{-4} \text{ mol}$ ✓

volume of it $= \frac{9.76 \times 10^{-4} \text{ mol}}{0.2 \text{ mol dm}^{-3}}$ ✓

$= 4.88 \times 10^{-4} \text{ dm}^3$ // ✓

(03 x 10 = 30 marks)

(02 x 10 = 20 marks)

C - 50