Provincial Department of Education - NWP

02	E	I

Second Term Test - Grade 13 - 2020

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 $R = 8.314\ J\ K^{-1}\ mol^{-1}$ | Avogadro constant $N_A = 6.022 \times 10^{23}\ mol^{-1}$
Planck's constant $h = 6.626 \times 10^{-34}\ J\ s$ | Velocity of light $C = 3 \times 10^{8}\ m\ s^{-1}$

1. Which of the following statement is true?
   1. An electric field is applied in the path of cathode rays, they are deflected perpendicular to the field.
   2. Cathode rays are beam of particles having mass and possess kinetic energy.
   3. The nature of cathode rays does not change on the nature of the gas taken in the discharge tube and change on the material of the cathode.
   4. Cathode rays are not deflected in a magnetic field.
   5. The ratio of the charge to mass ($^{e}/_{m}$ ratio) of cathode ray particles obtained from different gases is different from each.

2. The maximum number of electrons of an atom that are associated with principal quantum number, n and angular momentum quantum number l, where $n + l \leq 4$.
   1. 10 2. 30 3. 15 4. 20 5. 34

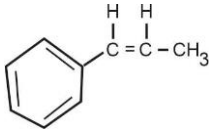
3. The number of stable resonance structures that can be drawn for N_2O molecule is?
   1. 1 2. 2 3. 3 4. 4 5. 5

4. What is the IUPAC name of the following Compound. $HOCH_2 - CH_2 - \underset{\displaystyle CHO}{\underset{|}{C}}H - CH_2COOH$

   1. 3 - formyl - 5 - hydroxidopentane - 1 - oic acid
   2. 5 - hydroxy - 3 - formylpentane - 1 - oic acid
   3. 3 - formyl - 5 - hydroxypentane - 1 - oic - acid
   4. 5 - hydroxy - 3 - formylpentanoic acid
   5. 3 - formyl - 5 - hydroxypentanoic acid

5. Which of the following statement is incorrect?
   1. The effective nuclear charge increases from left to right across a period.
   2. Covalent radius of Iodine is smaller than venderwaals radius of Iodine.
   3. Nuclear charge of iso electron species increases with increasing atomic number.
   4. Second ionization energy is maximum in Li.
   5. The highest amount of energy is released by F when gaining an electron.

6. The electron pair geometry around the Nitrogen atom, shape and oxidation number of Nitrogen atom in CH_3CONH_2 molecule respectively are,
   1. Trigonal planer, Trigonal planer , -3
   2. Tetrahedral , Trigonal Planer, -3
   3. Trigonal planer , Angular , -3
   4. Tetrahedral , Trigonal Planer , +3
   5. Tetrahedral , Pyramidal , -3

7. The correct statement regarding,  is ?

   1. All the carbon atoms lie in the same plane.
   2. All $C-H$ bond lengths have the same value in the molecule.
   3. All carbon atoms are sp^2 hybridized.
   4. All the $C-C-H$ and $C-C-C$ bond angles of the molecule have the same value.
   5. All the hydrogen atoms lie in the same plane.

08. $20.0\ cm^3$ of $0.10\ mol\ dm^{-3}$ $(NH_4)_2SO_4$ solution was added to $25.0\ cm^3$ of $0.20\ mol\ dm^{-3}$ $BaCl_2$ solution. The mass of $BaSO_4$ precipitate formed and the number of moles of the reactant remains respectively are,
(Ba = 137 , S = 32 , O = 16)
   1. $1.165\ g\ ,\ 2 \times 10^{-3}\ mol$
   2. $0.233\ g\ ,\ 3 \times 10^{-3}\ mol$
   3. $0.466\ g\ ,\ 3 \times 10^{-3}\ mol$
   4. $0.466\ g\ ,\ 2 \times 10^{-3}\ mol$
   5. $1.165\ g\ ,\ 3 \times 10^{-3}\ mol$

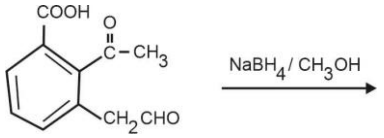
09. The mass reduction of test tube containing $KMnO_4$ which used to determine the molar volume of oxygen at 27^0C and $760\ torr$ is 0.48 g. O_2 gas evolved is collected over water. Saturated vapour pressure of water at 27^0C is 26.7 torr. What is the molar volume of oxygen under the conditions given above. (O = 16, 1 torr = 133.32 Pa)
   1. $25.51\ dm^3$
   2. $0.002551\ dm^3$
   3. $255.1\ dm^3$
   4. $24.61\ dm^3$
   5. $0.02461\ dm^3$

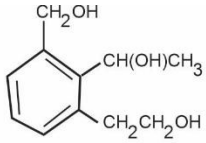
10. Decreasing order of the pH value in aqueous solutions given below is? 0.10 M HCl , 0.10 M HCOOH , 0.10 M KCl , 0.05 M $CH_3COO\ Na$, 0.10 M NaoH ($M = mol dm^{-3}$)
   1. $NaOH\ ,\ CH_3COO\ Na\ ,\ KCl\ ,\ HCOOH\ ,\ HCl$
   2. $HCl\ ,\ HCOOH\ ,\ KCl\ ,\ CH_3COO\ Na\ ,\ HCl$
   3. $NaOH\ ,\ KCl\ ,\ CH_3COO\ Na\ ,\ HCOOH\ ,\ HCl$
   4. $CH_3COO\ Na\ ,\ NaOH\ ,\ KCl\ ,\ HCOOH\ ,\ HCl$
   5. $HCl\ ,\ HCOOH\ ,\ CH_3COO\ Na\ ,\ KCl\ ,\ NaOH$

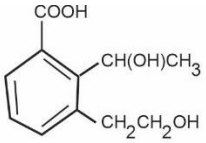
11. The increasing order of electronegativity of P atom in the chemical species PO_4^{3-} , PF_3 , $H_2PO_2^-$ and PCl_3 is?
   1. $H_2PO_2^- < PF_3 < PO_4^{3-} < PCl_3$
   2. $PO_4^{3-} < PCl_3 < PF_3 < H_2PO_2^-$
   3. $PCl_3 < H_2PO_2^- < PO_4^{3-} < PF_3$
   4. $H_2PO_2^- < PO_4^{3-} < PCl_3 < PF_3$
   5. $H_2PO_2^- < PCl_3 < PF_3 < PO_4^{3-}$

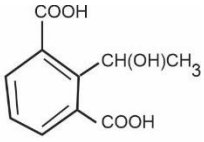
12. At T K water solubility of Ag_2CO_3 is $1.0 \times 10^{-4}\ mol\ dm^{-3}$. What is the solubility of Ag_2CO_3 in $0.01\ mol\ dm^{-3}$ $AgNO_3$ solution?
   1. $4.0 \times 10^{-8}\ mol\ dm^{-3}$
   2. $4.0 \times 10^{-10}\ mol\ dm^{-3}$
   3. $1.0 \times 10^{-10}\ mol\ dm^{-3}$
   4. $2.0 \times 10^{-8}\ mol\ dm^{-3}$
   5. $1.0 \times 10^{-8}\ mol\ dm^{-3}$

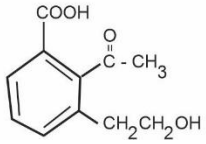
13. What is the major product of following reaction.

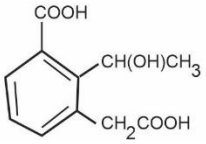


1. 

2. 

3. 

4. 

5. 

14. Identify the correct statement from the following.
    1. NH_3 can act as a base while can't act as an acid.
    2. Oxygen is highly electronegative element while vever show any positive oxidation state.
    3. All oxides formed by carbon show acidic properties.
    4. The bond angle of H_2O is larger that that of H_2S.
    5. Substances with atomic lattices never conduct electricity.

15. $50.0\ cm^3$ of $0.10\ mol\ dm^{-3}$ weak mono basic acid HA and $50.0\ cm^3$ of $0.05\ mol\ dm^{-3}$ NaOH were mixed. pH of the solution is,
    ($Ka_{(HA)} = 1.0 \times 10^5\ mol\ dm^{-3}$)
    1. 6 2. 4 3. 5 4. 5.5 5. 4.5

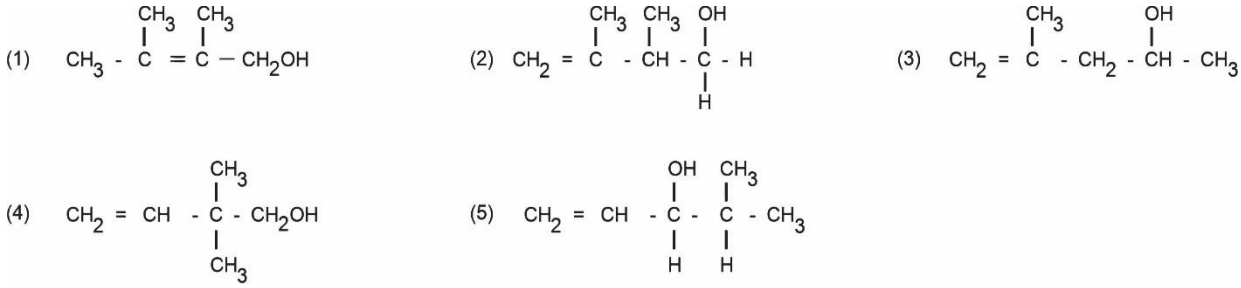
16. True regarding the following reaction,
    $2NO\ (g) + O_2(g) \rightarrow 2NO_2(g)$
    If formation enthalpies of $NO(g), O_2(g)$ and $NO_2(g)$ are $90.25\ kJmol^{-1}, 0.00\ kJmol^{-1}$ and $33.18\ kJmol^{-1}$ respectively.
    1. The above reaction is spontaneous at all temperatures.
    2. The above reaction is non spontaneous at all temperatures.
    3. The above reactions would be spontaneous only at high temperatures.
    4. The above reaction would be spontaneous only at low temperatures.
    5. Can't provided definite prediction on above reaction.

17. Which of the following statements is incorrect regarding phenol. (C_6H_5OH).
    1. Acidity of phenol is higher than acidity of alcohol.
    2. Phenol subjected to nucleophilic substitution reactions.
    3. Rate of Electrophilic substitution reactions of phenol is higher than beneze.
    4. Phenols do not subjected to acylation in the presence of friedle crafts catalysts.
    5 Phenols subjected to nitration in the presence of dil. HNO_3.

18. The increasing order of the conductivity of following samples of water is? Sea water, well water, distilled water, 1.0 M KCl , 0.10 M KCl ($M = moldm^{-3}$)
    1. Distilled water < Well water < 0.1M KCl < Sea water < 1.0 M KCl
    2. Well water < Distilled water < 0.1M KCl < Sea water < 1.0 M KCl
    3. Well water < Distilled water < 0.1M KCl < 1.0 M KCl < Sea water
    4. Distilled water < Well water < 0.1M KCl < 1.0 M KCl < Sea water
    5. Well water < Distilled water < Sea water < 0.1M KCl < 1.0 M KCl

19. The reaction $A + 2B \rightarrow D$ react according to the following elementary reaction steps.
$A + B \rightleftharpoons C$; fast equilibrium step, equilibrium constant K_c
$C + B \longrightarrow D$; slow
Rate expression for the reaction is,
1. Rate $= K_c[A]\ [B]$ 2. Rate $= K[C]\ [B]$ 3. Rate $= K[A]\ [B]^2$
4. Rate $= K[C]\ [B^2]$ 5. Rate $= K[A]\ [B]$

20. Compound A, with the molecular formula $C_6H_{12}O$ decolourzes bromine water (Br_2 / H_2O) Product B, obtained when A react with PCC gives dark yellow (orange) precipitate with Bready's reagent while, subjected to condensation reaction with, $NaOH(aq)$. Product X, obtained when B react with H_2/Ni gives colourless solution when treated with acidic $KMnO_4$. A would be?



21. Which of the following statement is true regarding disturbance applied for an equilibrium system?
1. Reaction reach to a new equilibrium changing the equilibrium constant when increase concentration at constant temperature.
2. When volume increases equilibrium shifted towards the direction where there are low gaseous species at constant temperature.
3. There is no change in the system when inert gas is added, as it does not participate to the reaction.
4. When catalyst is added, only the rate of forward reaction increase.
5. Exothermic reaction is favoured when increasing temperature.

22. At $298K$ K_c of the reaction $A_2(g) + 2B_2(g) \rightleftharpoons 2\,AB_2(g)$ is $2.5 \times 10^{26}\ mol^{-1}dm^3$. At $298K$ 0.50 mol A_2 (g), 0.50 mol of B_2 was allowed to react in a rigid vessel of $2\ dm^3$. Concentration of AB_2 (g) in the equilibrium mixture is,
1. $0.25\ mol\ dm^{-3}$ 2. $0.125\ mol\ dm^{-3}$ 3. $1.0\ mol\ dm^{-3}$
4. $0.50\ mol\ dm^{-3}$ 5. Correct answer is not given.

23. Which of the following statement is incorrect.
1. Conc. H_2SO_4 acid can act as oxidizing agent as well as dehydrating agent.
2. $NaHS(s)$ and $H_2(g)$ is produced when $Na(s)$ react with excess $H_2S(g)$.
3. $Na_2S(s)$ and $H_2O(l)$ is produced when $NaOH$ (aq) react with excess $H_2S(g)$.
4. MgO (s) and MgS (s) is produced when $Mg(s)$ react with $SO_2(g)$.
5. SO_2 (g) and H_2O (l) is produces when $S(s)$ react with con. H_2SO_4

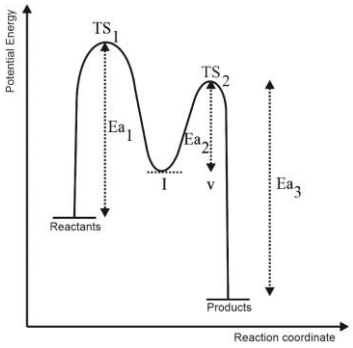
24. pH value of aqueous NaOH solution at $298K$ is 13.0. If the density of solution at 298 K is $1.15\ gcm^{-3}$, concentration of Na^+ in the solution in ppm is ? $(Na = 23)$

1. 20 2. 2000 3. 23 4. 200 5. 230

25. $\Delta H < 0$ for the reaction $N_2\,(g) + 3H_2\,(g) \rightleftharpoons 2NH_3(g)$. False statement regarding the responses when the above system at the equilibrium is disturbed.
    1. When concentration of $H_2(g)$ increases at constant temperature, no change in the equilibrium constant while equilibrium point shifted towards to forward.
    2. When volume increases at constant temperature, no change in equilibrium constant while equilibrium point shifted towards backward.
    3. Equilibrium constant decreases when temperature increases while equilibrium point shifted towards left.
    4. Equilibrium point changes when catalyst is added and therefore equilibrium constant changes.
    5. There is no change in the equilibrium constant as well as the equilibrium point when innert gas is added to the system.

26. Standard enthalpy change of the reaction $2A_2\,(g) + B_2\,(g) \rightarrow 2A_2B\,(g)$ is $-250 kJmol^{-1}$ at 298 K. True regarding the above reaction is?
    1. Reaction is spontaneous at all temperatures.
    2. The reaction would be taken place spontaneously at high temperatures.
    3. Entropy change of this reaction is a negative value.
    4. This reaction is not spontaneous at low temperatures.
    5. Can't predict anything regarding the Gibbs energy change of this reaction.

27. The following figure represents an energy diagram of a reaction.



Suitable reaction for the above energy diagram.

1. $CH_3Br + OH^- \rightarrow CH_3OH + Br^-$
2. $CH_3Br + CH_3CH_2O^- \rightarrow CH_3 - O - CH_2CH_3$
3. $(CH_3)_3CCl + CH_3C \equiv C^- \rightarrow (CH_3)_3\,C - C \equiv C - CH_3$
4. $CH_3Br + CH_3MgBr \rightarrow CH_3CH_3 + MgBr_2$
5. $CH_3Cl + CN^- \rightarrow CH_3CN + Cl^-$

28. $0.10\ mol\ dm^{-3}\ AgNO_3(aq)$ solution was hydrolyzed using inert electrodes at 300K and 1.0×10^5 Pa by passing 2.0 A current during 19.3 minutes. What is the volume of the gas evolved at the anode under above conditions?
($1F = 96500\ C\ mol^{-1}$)
    1. $5.986\ dm^3$
    2. $14.965\ dm^3$
    3. $1.4965\ dm^3$
    4. $5.986\ cm^3$
    5. $149.65\ cm^3$

29. Which group of the following group consist with equal or similar colours only.
    1. $[Co(H_2O)_6]^{2+}$, $[Mn(H_2O)_6]^{2+}$, $[Cr(H_2O)_6]^{3+}$
    2. $[Mn(H_2O)_6]^{2+}$, $[Cr(H_2O)_6]^{3+}$, $[Ni(H_2O)_6]^{2+}$
    3. $[Cu(NH_3)_4]^{2+}$, $[Ni(NH_3)_6]^{2+}$, $[FeCl_4]^-$
    4. $[Zn(NH_3)_4]^{2+}$, $[ZnCl_4]^{2-}$, $[Fe(H_2O)_6]^{2+}$
    5. $[CuCl_4]^{2-}$, $[NiCl_4]^{2-}$, $[FeCl_4]^-$

30. True regarding the equilibrium $Ca(OH)_2\,(s) \rightleftharpoons Ca^{2+}(aq) + 2OH^-\,(aq)$ is,
    1. Equilibrium shifted towards left when pH decreases and solubility of $Ca(OH)_2\,(s)$ decreases.
    2. Equilibrium shifted towards right when pH increases and solubility of $Ca(OH)_2\,(s)$ increases.
    3. Equilibrium shifted towards left when $CaCl_2(s)$ added and the solubility of $Ca(OH)_2\,(s)$ increases.
    4. Equilibrium shifted towards right when $NaOH\,(aq)$ solution added and solubility of $Ca(OH)_2\,(s)$ increases.
    5. Equilibrium shifted towards right when $Na_3PO_4\,(aq)$ solution added and solubility of $Ca(OH)_2\,(s)$ increases.

- **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**

31. Which of the following statement / statements is / are correct with regard to simple covalent molecules containing carbon and Nitrogen atoms.
  a. CO can behave as reducing agent.
  b. H_2CO_3 is strong dibasic acid.
  c. HNO_2 is unstable strong acid.
  d. HNO_3 is strong oxidizing agent.

32. Which of the following statement / statements is / are correct with regard to organic compounds.
  (a) Vinyl Halides subjected to nucleophilic substitution reactions.
  (b) Since any alcohols form hydrogen bonds with water, hence highly soluble in water.
  (c) Amides evolve Ammonia gas when heated with aqueous NaOH.
  (d) Phenol evolve CO_2 gas with Na_2CO_3 because phenol acidic than alcohols.

33. Which of the following statement / statements correctly named the enthalpy changes given below.
  (a) $Cl_2\,(g) \rightarrow 2\,Cl\,(g)$ standard atomization enthalpy.
  (b) $I_2\,(s) \rightarrow 2\,I\,(g)$ standard bond dissociation enthalpy.
  (c) $Na^+\,(g) + water \rightarrow Na^+\,(aq)$ standard hydration enthalpy.
  (d) $NaCl\,(s) \rightarrow Na^+(g) + Cl^-(g)$ standard lattice dissociation enthalpy.

34. Which of the following statement / statements is / are true regarding experiments of the identification of anions.
  (a) Solution with white precipitate obtained when an aqueous $AgNO_3$ solution added to S^{2-} ion containing solution, turns black when heating.
  (b) Solution obtained with white precipitate when $Pb(CH_3COO)_2$ solution is added to $S_2O_3^{2-}$ ion containing solution turns black when heating.
  (c) The gas evolved when dil HCl added to an solid compound containing SO_3^{2-} followed by heat turns filter paper dipped in $H^+/K_2Cr_2O_7$ to green.
  (d) Brown coloured gas is evolved, when dil. HCl is added to solid compound containing NO_3^- and heat.

35. Which of the following reaction / (s) is / are nucleophilic addtion reaction / reactions?

(a) $CH_3-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow{NaOH(aq)} CH_3-\overset{O}{\overset{\|}{C}}-O^-Na^+$

(b) $CH_3-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[(ii)\ H^+/H_2O]{(i)\ CH_3MgBr\ /\ Dry\ ether} CH_3-\overset{OH}{\overset{|}{C}}(CH_3)-CH_3$

(c) $(CH_3)_3CBr \xrightarrow{R-C\equiv C^-} (CH_3)_3C-C\equiv C-R$

(d) $CH_3-\overset{O}{\overset{\|}{C}}-H \xrightarrow{HCN} CH_3-\overset{OH}{\overset{|}{C}}(H)-CN$

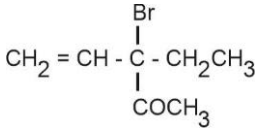
36. Which of the following statement / statements is / are true?
   (a) Gas evolved when, water is added to the product obtained when Mg burn in air, turns filter paper dipped in Nestler reagent to brown.
   (b) The solution turns pink, when cleaned piece of Mg is added to a test tube containing water and phenolphthalein.
   (c) Precipitate obtained when dil. HNO_3 and $AgNO_3$ added to a solution contering I^- ions, dissolve in conc. NH_3.
   (d) Precipitate obtained when $Pb(CH_3COO)_2$ added to Br^- ions containing solution gives a colourless solutions when diluted with water and heat.

37. Which of the following statement / statements is / are true with regard to elements of 3d block.
   (a) Sc and Zn are not considered as transition elements among the d block elements.
   (b) All the metals of 3d block from cations with variable oxidation states.
   (c) Elements of 3d block do not react with cool water.
   (d) First ionization energy of 3d block elements is higher than the first ionization energy of s block elements in the 4th period.

38. Ideal solution consist with 2.0 mol of A and 3.0 mol of B exist in equilibrium with its vapour at 298K. At 298 K saturated vapour pressures of A and B are 1.2×10^4 Pa and 1.5×10^4 Pa respectively. Which of the following is / are true with regards to above equilibrium system.
   (a) Total pressure in the vapour phase is 6.9×10^4 Pa .
   (b) Mole fraction of A(s) in the vapour phase is 0.3478.
   (c) Mole fraction of B(g) in the vapour phase is 0.6522.
   (d) Mole fraction of B in vapour phase is increased when particular amount of B is added to the liquid phase in the equilibrium system.

39. Which of the following statement / statements is / are true?
   (a) Any indicator can be used for the titration between $0.001\ mol\ dm^{-3}$ NaOH and $0.001\ mol\ dm^{-3}$ HCl.
   (b) The indicator Methyl orange is suitable for the titration between $0.10\ mol\ dm^{-3}$ NH_4OH and $0.10\ mol\ dm^{-3}$ HCl.
   (c) The indicator Phenolpthaline is suitable for the titration between $0.10\ mol\ dm^{-3}$ CH_3COOH and $0.10\ mol\ dm^{-3}$ NaOH .
   (d) The indicator Phenolpthaline is more suitable for the titration between $0.10\ mol\ dm^{-3}$ CH_3COOH and $0.10\ mol\ dm^{-3}$ $NH_3\ (aq)$.

40. Which of the following statement / statements is / are true with regards to compound X.

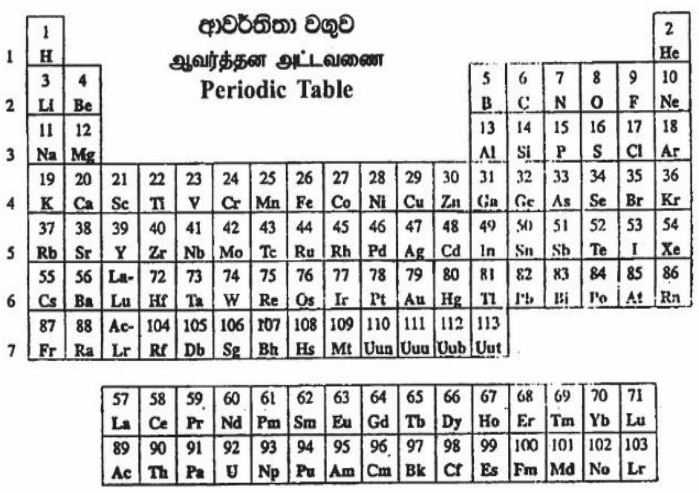
X = 

   (a) Product obtained when X, react with HBr show enantiomorism. (Optical isomerism)
   (b) Product obtained when X, react with $Zn(Hg)$ / conc.HCl show enantiomers (optical isomerism)
   (c) X, show enantiomerism (optical isomerism)
   (d) X show disateriomerism (Geometric isomerism)

- **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.	HF is a weak acid while HCl is a strong acid.	Electronegativity of F is higher than the electronegativity of Cl
42.	Stability of a system decreases with increasing randomness.	Entropy change which is a measurement of randomness depend on temperature, physical nature and the organization of particles.
43.	Real gases reach to ideal behaviour at high temperature and low pressures.	Inter molecular attractions among gaseous molecules at high temperature and low pressure conditions is strong.
44.	Aldehydes and ketones with relatively lower molecular masses are soluble in water.	Aldehydes and Ketones can from intermolecular H − bonds with water.
45.	Critical temperature of NH_3 is lower than the critical temperature of H_2O.	Strength of inter molecular attractions among NH_3 molecules is lower than strength of inter molecular attractions among H_2O molecules.
46.	Basicity of primary aliphatic amines is lower than the basicity of aniline.	Lone electron pair on Nitrogen in aniline is delocalized to aromatic ring by resonance.
47.	Basicity of NH_3 can be explained by Arrhenius theory.	Lone electron pair on N in NH_3 can be accepted by H^+ ion.
48.	Any indicator can be used for the titration between $0.001\ moldm^{-3}$ HCl and $0.001\ moldm^{-3}$ NaOH	Ionization and non ionization types of acid base indicator consist with different colours.
49.	Diazonium salt gives C_6H_5I with KI.	$N \equiv N^+$ group act as the electrophile.
50.	Cu^{2+} cannot be precipitate as CuS by bubbling H_2S in basic medium.	Low concentration of S^{2-} is required to precipitate Cu^{2+} ions as CuS.



වයඹ පළාත් අධ්‍යාපන දෙපාර්තමේන්තුව

Provincial Department of Education - NWP

02 | E | II

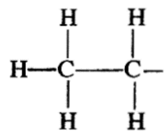
Second Term Test - Grade 13 - 2020

Index No : ....

Chemistry II

Three Hours

* *A Periodic Table is provided on page 16.*
* ***Use of calculators is not allowed.***
* *Universal gas constant, $R = 8.314\ J\ K^{-1}\ mol^{-1}$*
* *Avogadro constant, $N_A = 6.022 \times 10^{23}\ mol^{-1}$*
* **In answering this paper, you may represent alkyl groups in a condensed manner.**

Example:  group may be shown as CH_3CH_2-

❑ **PART A — Structured Essay (pages 2 - 8)**

* *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 answers are not expected.*

❑ **PART B and PART C — Essay (pages 9 - 15)**

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

For Examiner's Use Only

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

Final Mark

In Numbers	
In Letters	

Code Numbers

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

Part A - Structured Essay

(01) (a) Arrange the following element / compound in the increasing order of the property indicated in parenthesis.

(i) LiO, K_2O, SiO_2, MgO (Basicity of the product obtained when react with water)

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

(ii) $AgCl, AgBr, AgI$ (Solubility in $NH_3(aq)$)

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

(iii) Mn_2O_7, MnO_2, MnO, MnO_3 (acidity)

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

(iv) S, Cl, Ar, C (Boiling point)

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

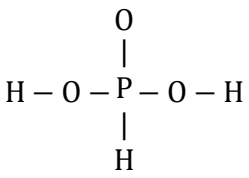
(v) Li, Be, Mg, Ba (Rate of the reaction with water)

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

(vi) $COCl_2$, $C_2H_4Cl_2$, HCN (S character of the hybridization of central atom.)

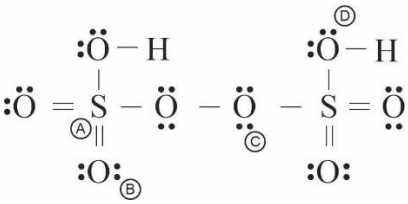
..... < ..... < .....

(b) i. Draw the Lewis structure for the H_3PO_3 which is an oxi acid of Phosporous.



ii. Draw all the Lewis dot - dash structures (resonance structures) could be drawn for above molecule.
Comment on the stability of those structures giving one reason each.

(c) Based on the Lewis dot - dash structure given below state the following regarding the C, N and O atoms given in the table.



i. VSEPR pairs around the atom.
ii. Electron pair geometry around the atom.
iii. shape around the atom.
iv. Hybridization of the atom.
vi. Oxidation number of the atom.

Atom	S_A	O_B	O_C	O_D
VSEPR pairs around the atom				
Electron pair geometry around the atom.				
shape around the atom.				
Hybridization of the atom.				
Oxidation number of the atom.				

(d) Mention whether the following statements are true or false. Write reasons briefly.

(i) Boiling point of otho-nitrophenol is lower than the boiling point of Para - nitrophenol.

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(ii) Zn and Sc are transition metals of d block.

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(02) (a) X is an element belong to the p block where atomic number is less then 20. There is an unpaired electron in X. X is used to bleach cloths and paper.

(i) Identify X

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(ii) Write condensed electron configuration of X

.....

(iii) Write formula of compounds formed by X with elements of third period. Mention acidic / basic or amphoteric nature of them.

Element	Na	Mg	Al	Si	P
Compound					
Nature					

(iv) Write an example for X as oxidizing agent.

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(v) Write the reaction of X with water. What is the type of that reaction?

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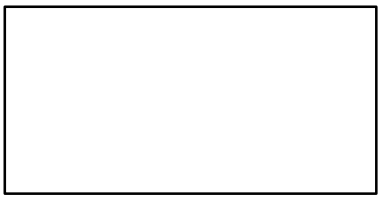
(vi) Draw structures of two oxo acids formed by X and write IUPAC name.



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(b) Test tubes labelled A to E contain solid compounds of $CaCO_3$, $BaCl_2$, $AgNO_3$, $ZnSO_4$ and NaOH (not in order). Observations obtained when they are subjected to some experiments are given below.

	Experiment	Observation
(a)	Dissolve each compound separately in water.	All compounds dissolve except compound D.
(b)	Dil HCl added to part of aqueous solutions each from A, B, C and E.	Only C gave a white precipitate.
(c)	Dil. H_2SO_4 added gradually in to A, B and E separately as above.	Only E gave a white precipitate while it does not dissolve in excess dil. H_2SO_4.
(d)	Aqueous NH_3 added separately to aqueous solutions of A and B.	Only B gave a white gelatinous precipitate.

(i) Identify A, B, C, D, and E.

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

C ..... D .....

E .....

(ii) Write the chemical formula and IUPAC name of the product obtained when excess dil. NH_3 added to the product formed when compound C react with dil. HCl.

.....

(iii) If flame test carried out for above compounds. Select the compound which give characteristic colour to the flame and write the colour.

Compound	Colour of the flame

(03) (a) It was observed the reaction between A and B do not start till heat to 400K temperature.

At 400K, the reaction is

$A(g) + B(g) \rightarrow C(g) + D(g)$

(i) Explain briefly the reason that the reaction do not start till heat to 400K.

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(ii) Reaction takes place rapidly when the reaction mixture kept in the room temperature and small amount of d block element was added. Explain the reason briefly.

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(iii) Draw boltzman distribution curves for above gaseous mixture at 300K and 400K.

(iv) At 500K the above reaction mixture reach to the following equilibrium.

$A(g) + B(g) \rightleftharpoons C(g) + D(g)$ What is the value of ΔG ?

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(b) (i) Define pH value.

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(ii) At TK temperature $10cm^3$ of $0.1\ moldm^{-3}$ HCl solution and $10cm^3$ of $0.01\ moldm^{-3}$ H_2SO_4 solution were mixed. If there is no volume change what is the pH of the solution.

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(iii) If the ionic product of water is Kw, show OH^- concentration of above solution is, $\log_{10}\ [OH^-(aq)] = pKw + pH$.

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(iv) Calculate $[OH^-\ (aq)\ ]$ of above solution using above or any other method.

At that temperature $Kw = 1.2 \times 10^{-10}\ mol^2dm^{-6}$.

(04) (a) A, B, C, D and E are five mono substituted aromatic alcohols with the molecular formula $C_9H_{12}O$. They show following properties.

Only A and D do not show enontiomerism while B, C and E show enantiomerism. Compound A oxidized by PCC to form P, while D do not undergo oxidation by PCC. B, C and E compounds are oxidized are PCC producing Q, R and S respectively. S gives silver mirror with $NH_3/\ AgNO_3$ and Q,R is not. There is a chiral carbon in the product when Q react with CH_3CH_2MgBr and hydrolysed.

i. Draw the structures of alcohol molecules A , B , C , D and E in the boxes given below.

A B C

D E

ii . Draw structures of the compounds P, Q, R and S.

P Q R S

iii. Write an experiment to identify A and D with observations.

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Write experiment to identify P and Q with observation.

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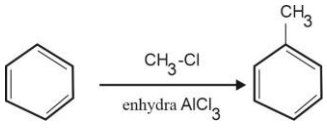
(b) Consider the following reaction.



i Give acceptable mechanism for the above reaction.

ii Write two importance of Anhydrase $AlCl_3$.

.....

.....

iii What is the anion act as Lewis base in the above reaction.

.....

(b) Write the major organic product of each of the following reaction.

(i) $CH_3 - \overset{\overset{O}{\|}}{C} - CH_3 \xrightarrow{NaOH(aq)}$ ☐

(ii) $CH_3 - C \equiv C - H \xrightarrow{NaNH_2}$ ☐

(iii) $C_6H_5 - OH \xrightarrow{CH3 - \overset{\overset{O}{\|}}{C} - Cl}$ ☐

(iv) $CH_3 - CH = CH_2 \xrightarrow{Conc.\ H_2SO_4}$ ☐

(v) $CH_3CH_2 - Br \xrightarrow{Conc.\ NH_3}$ ☐

(vi) $CH_3 - \overset{\overset{O}{\|}}{C} - Cl \xrightarrow[NaOH]{Excess\ aq.}$ ☐

(vii) $C_6H_5 - CHO \xrightarrow{Cl_2 / නි. AlCl_3}$ ☐

(vii) $HO - CH_2CH_2 - Cl \xrightarrow{Mg/\ dry\ ether}$ ☐

(ix) $CH_3 - \overset{\overset{O}{\|}}{C} - O - CH_3 \xrightarrow{C_6H_5MgCl}$ ☐

(x) $C_6H_5\overset{+}{N} \equiv N\overset{-}{Cl} \xrightarrow{H2O / \Delta}$ ☐

First Term Test – 2020
Chemisty 13 – II - PART B

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

(05) (a) At 27^0 C 0.50 mol of A (s) and 0.80 mol of B (g) were mixed inside a rigid vessel of 4.157 dm^3. At 27^0 C there is no any reaction between A(s) and B(g) . While when the system heated to 127^0 , A (s) react with B(g) forming C(g) and reached to the following equilibrium.

$2A(s) + 3B(g) \rightleftharpoons 2C(g) \quad - \quad (1)$

0.20 mol of C(g) was formed at this stage. When the system heated to the $427\,^0C$ instead of the above equilibrium, C(g) dissociated to D(g) and E(g) reaching to the following equilibrium.

$C(g) \rightleftharpoons D(g) + E(g) - \quad (2)$

0.20 mol of B(g) and 0.25 mol of D(g) was formed in the system at this stage.

(i) Calculate total pressure of the equilibrium system at 127^0 C .
(ii) Calculate equilibrium constant Kp for the system (1) at 127^0 C .
(iii) Use Kp above (ii) to calculate Kc at 127^0 C
(iv) Calculate partial pressures of each gas of the system at 427^0 C.
(v) Calculate Kp values for equilibrium (1) and (2) at 427^0 C
(vi) Using Kp values at two temperature conditions explain reaction (1) is exothermic or endothermic giving reasons.
(vii) 0.20 mol of B(g) and 0.10 mol of C(g) added from outside to the equilibrium system at 127^0 C . Show using suitable calculation to which direction the above equilibrium (1) moved.

(b) (I) Mention following thermochemical data using equations.

(i)	Standard sublimation enthalpy of Na(s)	=	$+ 108$ kJmol^{-1}
(ii)	Standard first ionization enthalpy of Sodium	=	$+ 500$ kJmol^{-1}
(iii)	Standard formation enthalpy of NaBr(s)	=	$- 411$ kJmol^{-1}
(iv)	Standard vaporization enthalpy of Br_2(l)	=	$+ 30.91$ kJmol^{-1}
(v)	Standard bond dissociation enthalpy of Br_2(g)	=	$+ 192$ kJmol^{-1}
(vi)	Standard electron gain enthalpy of Br(g)	=	$- 325$kJmol^{-1}
(vii)	Standard lattice dissociation enthalpy of NaBr(s)	=	$+$ x kJmol^{-1}

(II) Build a suitable Born Haber cycle to calculate standard lattice dissociation enthalpy of NaBr(s) using data given above (I) and use it to calculate the value of x.

(c) Water solubility of MSO_4 (s) at 298K is 2×10^{-6} moldm^{-3} .
(i) Calculate solubility product of MSO_4 (s) at 298 K.
(ii) Find the solubility of MSO_4 in 1×10^{-2} mol dm^{-3} Na_2SO_4 Solution.
(iii) Show using a suitable calculation whether there is a precipitate or not when mixing 50.0 cm^3 of 1×10^{-5} mol dm^{-3} Na_2SO_4 and 50.0 cm^3 of 2×10^{-5} mol dm^{-3} $M(NO_3)_2$ Solutions.

(06) (a) Consider the titration between $0.20\ \text{mol dm}^{-3}$ NaOH solution and $0.10\ \text{mol dm}^{-3}$ CH_3COOH at 25^0C Here $25.0\ \text{cm}^3$ of CH_3COOH was taken to a titration flask and $0.20\ \text{mol dm}^{-3}$ NaOH in the burette is added gradually.
At 25^0C $Ka_{(CH_3COOH)} = 1.8 \times 10^{-5}\ \text{mol dm}^{-3}$

(i) Calculate pH of initial CH_3COOH.
(ii) Calculate pH of the solution in the titration flask when $10.0\ \text{cm}^3$ of NaOH added to the titration flask.
(iii) Can the solution in (ii) above to act as butter solution? Explain your answer.
(iv) Calculate the volume of NaOH required to reach the equivalence point?.
(v) Calculate the pH of equivalence point.
(v) Calculate the pH of the solution in the titration flask when $20.00\ \text{cm}^3$ of NaOH added to the titration flask.
Can this solution to act as buffer solution? Explain your answer.
(vi) Draw a rough sketch of the variation of pH in the mixture of titration flask varies with the strong base solution added. (Name axis , y axis as pH , x axis as volume of strong base added, mark the equivalence point)
(vii) Which of the following indicators is suitable for this titration.

Indicator	pH range of indicator
A	3 - 5
B	6 - 8
C	8 - 10
D	7 - 9

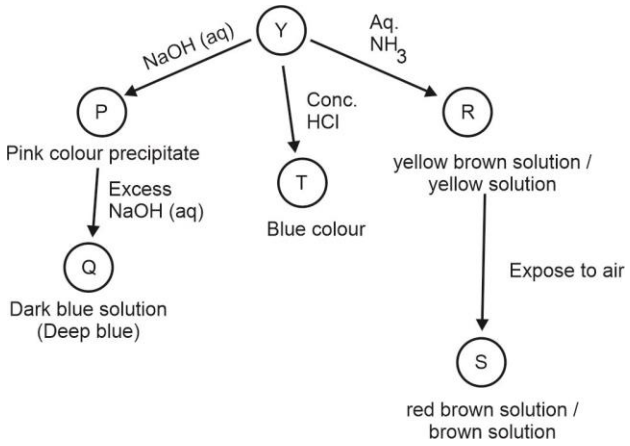
(b) (I) Find the amount of heat required to convert 90kg of ice at 20^0C to water at 0^0 C .
Specific heat capacity of ice $S = 2.09\ \text{J g}^{-1}\ ^0\text{C}^{-1}$
Enthalpy of fusion for ice at 0^0 C is $6.0\ \text{kJ mol}^{-1}$.
(II) A and B mixed to form an ideal solution. Total vapour pressure of a solution consist with 2 mol of A and 3 mol of B at 298K is 6.4×10^4 Pa .
At this temperature saturated vapour pressure of pure A is 5.0×10^4 Pa .
(i) Calculate saturated vapour pressure of pure B at 298 K.
(ii) Calculate mole fractions of A and B in vapour phase,which exist in the equilibrium with above solution at 298K.
(iii) Draw rough sketch of the vapour pressure composition curve for above system. (Should mention total vapour pressure $P_{AB,}$ partial pressure of A and B, variation of P_A, P_B.)

(07) (a) (I) Electro chemical cell was formed by using standard Magnesium electrode and chlorine electrode.
$E^{\theta}_{(Cl_2\ (g)\ /\ Cl^-)} = +1.36\ \text{V}$
$E^{\theta}_{(Mg^{2+}\ (aq)\ /\ Mg(s))} = -2.37\ \text{V}$
(i) Identify anode and cathode of the cell.
(ii) Write anode reaction and cathode reaction.
(iii) Write the overall cell reaction.
(iv) Name the cell in IUPAC notation.
(v) Calculate electro motive force of the cell.

(II) $250.0\ cm^3$ of $0.5\ mol\ dm^{-3}$ $CuSO_4$ solution was hydrolysed by passing $2.0\ A$ current for 1 hour using carbon electrodes.
($Cu = 63.5$, $1F = 96500\ C\ mol^{-1}$)

(i) Draw and name a sketch of apparatus set up used for the hydrolysis.
(ii) Write reactions taking place at the anode and cathode.
(iii) Mention whether the mass of cathode increases or decreases? Calculate the relevant mass.
(iv) Calculate the concentration of $CuSO_4$ solution after 1 hour.
(v) Mention your assumptions in calculation (iv) above.

(b) (I) Transition metal X form coloured complex ion Y in aqueous medium. Y has $[X(H_2O)_m]^{n+}$ type chemical formula.
Y subjected to following reactions.



(i) Identify metal X.
(ii) Identify the oxidation number of X in the complex Y.
(iii) Write the electron configuration of X in the complex ion Y.
(iv) Identify the values of m and n.
(v) What is the geometry of Y.
(vi) Identify structures P, Q, R, S and T.
(vii) Write IUPAC names of complexes Y, Q, T, R and S.

(II) A, B and C are complex compounds. All of them possess octahedral geometry. Molecular formulae of them (not in order) are.
$COCl_2IN_4H_{12}$, $CoClBrN_5O_2H_{12}$ and $CoCl_3N_4H_{12}$.
When small amount of $CHCl_3$ and Cl_2 water added to aqueous solutions of above compounds produce following observations.

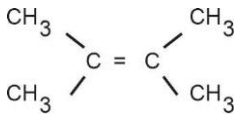
Compound	Observation when $CHCl_3$ and Cl_2 water added.
A	No change in the $CHCl_3$ layer.
B	$CHCl_3$ layer turns purple.
C	$CHCl_3$ layer turns orange.

(i) Give structures of A, B and C
(ii) Write reactions taken place when $CHCl_3$ and Cl_2 water is added. (consider relevant ions only)
(iii) Write one experiment each and the observations to identify if any ionic anion / anions exist in above compounds except the experiment given above.

Part - C ESSAY

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

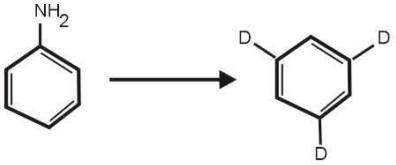
(08) (a) Using $CH_3CH_2CH_2OH$ as the only organic starting material and as reagents only those given in the list, show how would you synthesize the following compound in not more than eight (08) steps.



List of reagent.
PCC, Conc. H_2SO_4 , H^+ / H_2O , Mg / dry ether, dil H_2SO_4 , PCl_5

(b) Show how you would carry out each of the following conversions in not more than five (05) steps.

(i)



(ii)

(c) Consider the following reactions.

(i) Mention the type of the reaction above.
(ii) Mention acceptable mechanism for the above reaction.

(09) (a) A is a colourless solid. When A is heated white coloured solid B remains, evolving a colourless gas C. B react with dil. H_2SO_4 forming brown coloured gas. When B is heated with NH_4Cl produce colourless gas D and compound E. When A heated with $(NH_4)_2SO_4$ remains white coloured solid G, evolving colourless gas F. Both E and G gave yellow colour to the bunsen flame. Gas C react with heated Mg. Gas D also react with heated Mg. Product obtained here produce NH_3 gas with the reaction of water.

(i) Identify substances A to G.
(ii) Write balanced chemical equations for all the reactions above.

(b) Aqueous solutions of compounds $Zn(NO_3)_2$, $(NH_4)_2SO_4$, CH_3COONH_4 and $Ba(NO_3)_2$ exist in 4 different test tubes without labels. Mention how you would identify each of above compound by using on aqueous $NaOH$ solution only.

(c) 1.6 g of alloy consist with Au, Ag and Cu only dissolve in excess conc. HNO_3 solution. (Only Au does not react with conc. HNO_3) Solution obtained was filtered to separate Au and excess HCl added to the filtrate. Mass of the precipitate obtained after filtered and dried is 0.287 g. Excess KI added to the remaining solution and released I_2 was titrated by $0.10\ moldm^{-3}$ $Na_2S_2O_3$ solution. Burette reading at the end point is $40.0\ cm^3$.
($Ag = 108$, $Cu - 63.5$, $Cl = 35.5$)

(i) Write the balanced chemical equations for all the reactions above.

(ii) Mention the indicator used for the above titration and mention at which stage you add the indicator and write reason for that.

(iii) Find masses of Au, Ag and Cu in the alloy.

(10) (a) Write IUPAC names of complex compounds and ions given below.

(i) $[NiCl_4]^{2-}$

(ii) $[CO(NH_3)_6]^{2+}$

(iii) $K_2[CoCl_4]$

(iv) $[Mn(H_2O)_6]I_2$

(b) Write balanced chemical equation for following.

(I) $HNO_3\,(aq) \xrightarrow[\text{(light)}]{h\upsilon}$

(II) $Cu(s) + \text{dil.}HNO_3\,(aq) \longrightarrow$

(III) $(NH_4)_2Cr_2O_7(s) \xrightarrow{\Delta}$

(IV) $NCl_3\,(l) + H_2O\,(l) \longrightarrow$

(V) $BiCl_3\,(aq) + H_2O\,(l) \longrightarrow$

(VI) $NaO_2(s) + H_2O\,(l) \longrightarrow$

(c) (i) $1.0\ dm^3$ solutions was prepared by dissolving a mixture of anhydrous $FeSO_4$ and $Fe_2(SO_4)_3$ in acidified water. $20.0\ cm^3$ of $KMnO_4$ solution was required to react with $25.0\ cm^3$ of above solution.

(ii) Another sample of $25.0\ cm^3$ of above solution was taken and all Fe^{2+} was convered to Fe^{3+} using Zn. $30.0\ cm^3$ of $KMnO_4$ solution was required to react completely with this solution.

(iii) Following method was used to determine the concentration of above $KMnO_4$ solution.
$500\ cm^3$ solution was prepared by dissolving $2.52\ g$ of $H_2C_2O_4\,.\,2\,H_2O$ in water.
$24.0\ cm^3$ $KMnO_4$ solution above was required to react completely with $25.0\ cm^3$ of this solution. Titration flask with $H_2C_2O_4$ was heated to about 60^0 C before the titration. $(H = 1.0\,, C = 12.0\,, O = 16)$

1. Write balanced ionic / non ionic equations for I, II and II.
2. Calculate the concentrations of $KMnO_4$ solution.
3. Calculate concentrations of $FeSO_4$ and $Fe_2(SO_4)_2$ solutions.
4. Mention the reason to heat the titration flask containing of $H_2C_2O_4$ to about 60^0 C.