Grade 12 3rd
2019 July (11)
Visakha.

AL/2019/02 /S-I

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Co/Visakha Vidyalaya, Colombo - 05

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General Certificate of Education (Adv. Level) Examination, 2019

රසායන විද්‍යාව I
Chemistry I

02 E I

පැය දෙකයි
Two hours

- ❋ This paper consists of 8 pages.
- ❋ Answer all the questions.
- ❋ Use of calculators is not allowed.
- ❋ Write your index number in the space provided in the answer sheet.
- ❋ Follow the instructions given on the back of the answer sheet carefully.
- ❋ In each questions 1 to 50, pick one of the answer sheet with a cross (x) in accordance with the instructions given on the back of the answer sheet.

Grade -12

3rd Term Test
2019 -July

Universal gas constant R = 8.314 J mol^{-1} K^{-1}
Avogadro constant/N_A = 6.022×10^{23} mol^{-1}
Plank's constant h = 6.63×10^{-34} JS
Velocity of light C = 3×10^{8} m S^{-1}
Faraday constant/F = 96500 $Cmol^{-1}$

(1) The set of quantum number $n, l, m_l,$ and m_s in order to describe the unpaired valence electron in the ion X^{4+} of $^{51}_{23}X$ atom

(1) 4 ,2, 1 , -1/2 (2) 3 ,1 , 1 , +1/2 (3) 3 ,2, -1, -1/2
(4) 3 , 2 , 3 , ½ (5) 4 , 1 , 2 , 1/2

(2) Which of the electron geometry of following molecule does not match with the electron geometry of ICl_2^-?

(1) IF_3 (2) SF_4 (3) SbF_5 (4) IO_3^- (5) PCl_5

(3) The IUPAC name of CH_3-CCl=CH-CH_2-CHO is
(1) 4- chloropent-3-ene-1-al
(2) 4-chloropent-3-eneal
(3) 4-chloropent-3-enal
(4) 4-chloropent-1-al-3-ene
(5) 2-chloropent-2-en-5-al

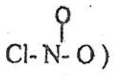
(4) The correct increasing order of the bond angle is,
(1) $BF_3 < SF_6 < CH_4 < NH_3 < BeCl_2$
(2) $CH_4 < NH_3 < SF_6 < BF_3 < BeCl_2$
(3) $SF_6 < CH_4 < NH_3 < BF_3 < BeCl_2$
(4) $SF_6 < NH_3 < CH_4 < BF_3 < BeCl_2$
(5) $SF_6 < BF_3 < NH_3 < CH_4 < BeCl_2$

(5) What is the de-Broglie wave length of an electron with a speed equal to 1% less of the speed of light ?

(1) 2.45 pm (2) 2.4 nm (3) 24.5 pm (4) 24.5 nm (5) 0.25 pm

(6) Which of the following shows the variation of root mean square velocity of 1 mole of an ideal gas at constant pressure (d= density of the gas)

(1) d (2) d^2 (3) $\sqrt{d}$ (4) $\sqrt{\frac{1}{d}}$ (5) $\frac{1}{d}$

(7) Which of the following statement is true for NO_2Cl (The skeleton is  $Cl-\overset{O}{N}-O$)

(1) The oxidation state of N is -3

(2) The oxidation state of two O atoms are different

(3) N atom possess SP^3 hybridization

(4) The bond length of two N- O bonds are the different

(5) All these atoms are in the same plane

(8) $A_{2(g)} + 3B_{2(g)} \longrightarrow 2AB_{3(g)}$

The above reaction is thermodynamically spontaneous at 298K, but non spontaneous at high temperatures. Which of the following is true about the reaction at 298K?

	ΔG	ΔH	ΔS
(1)	+	+	−
(2)	+	−	+
(3)	−	−	−
(4)	+	+	+
(5)	−	−	+

(9) The number of stereo isomers shown by alcohol ,with C_4H_8O molecular formula is ,

(1) 1 (2) 3 (3) 6 (4) 8 (5) 10

(10) The compound which shows all below observations is ,

- The aqueous solution of the salt forms a black precipitate when bubbling H_2S gas in an acidic medium
- The cation of the salt form a hydroxide which dissolves in excess NaOH
- Aqueous solution of the salt does not decolorizes $H^+/ KMnO_4$ solution but gives a basic gas with Al powder and NaOH when heated

(1) $BiCl_3$ (2) $Bi(NO_2)_3$ (3) $Bi(NO_3)_2$ (4) $Pb(NO_3)_2$ (5) $Pb(NO_2)_2$

(11) Disulphide dichloride (S_2Cl_2) is used to vulcanize rubber. S_2Cl_2 is made by heating Sulphur with chlorine as follow.

$S_8 + Cl_2 \longrightarrow S_2Cl_2$ (not balanced)

The mass of S_2Cl_2 when 3.84g of S_8 reacts with 5.68g of chlorine is,

(S=32 , Cl = 35.5)

(1) 2.7 (2) 16.2 (3) 10.8 (4) 8.1 (5) 2.03

(12) Which of the following chemical reactions corresponds to the standard enthalpy of formation of $Cd(NO_3)_{2\,(s)}$?

(1) $Cd^{2+}_{(g)} + 2NO^-_{3(g)} \longrightarrow Cd(NO_3)_{2(s)}$

(2) $Cd_{(g)} + 2N_{(g)} + 6O_{(g)} \longrightarrow Cd(NO_3)_{2(s)}$

(3) $Cd_{(s)} + N_{2(g)} + 3O_{2(g)} \longrightarrow Cd(NO_3)_{2(s)}$

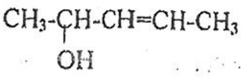
(4) $Cd^{2+}_{(g)} + 2N_{(g)} + 6O^-_{(g} \longrightarrow Cd(NO_3)_{2(s)}$

(5) $Cd_{(g)} + 2N^-_{(g)} + 3O_{(g)} \longrightarrow Cd(NO_3)_{2(s)}$

(13) 2.67g of trivalent chloride of the element M is dissolved in water and acidified with dilute HNO_3.The mass of the precipitate obtained after adding $Pb(NO_3)_2$ was 8.34g.The relative atomic mass of M is,
(Pb= 207 , Cl= 35.5)

(1) 11 (2) 14 (3) 27 (4) 31 (5) 70

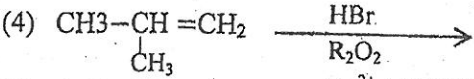
(14) Which of the following statement is false about $CH_3\text{-}\underset{OH}{CH}\text{-}CH{=}CH\text{-}CH_3$



(1) It shows 4 optical isomers.
(2) It shows 2 geometrical isomers.
(3) It turns the colour of the alkaline $KMnO_4$ solution in to brown.
(4) When reacting with Ni/D_2 it does not form an alkane (D- deuterium)
(5) It dissolves in dilute H_2SO_4

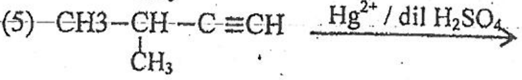
(15) Select the reaction which forms a compound with two chiral C atoms.

(1) $CH_3CH{=}CH_2 \xrightarrow{HBr}$
(2) $CH_3CH{=}CH_2 \xrightarrow{\text{Conc } H_2SO_4}$
(3) $CH_3-CH_2-CH{=}CH_2 \xrightarrow{\text{dil } H_2SO_4}$
(4)



$CH3-\underset{CH_3}{CH}{=}CH_2 \xrightarrow[R_2O_2]{HBr}$

(5)



$CH3-\underset{CH_3}{CH}-C{\equiv}CH \xrightarrow{Hg^{2+} / \text{dil } H_2SO_4}$

(16) A sodium lamp produce energy of 8.0 J per second in yellow region (580nm) of the visible light. How long the lamp should be light up in order to produce 1×10^{21} photons?

(1) 23 (2) 32 (3) 36 (4) 43 (5) 45

(17) Which of the following statement is correct?

(a) HBr can be oxidized to Br_2 by dilute H_2SO_4
(b) HCl can be oxidized to Cl_2 by dilute $KMnO_4$
(c) HI can be oxidized to I_2 by conc H_2SO_4
(d) HF can be oxidized to F_2 by $K_2Cr_2O_7$

(1) a , b (2) b , c (3) c , d (4) d , a (5) a, c

(18) When solution X which containing two cations, is acidified with dilute HCl and H_2S is passed a coloured precipitate is obtained. To aqueous solution of X, excess amount of dilute NH_4OH is added. A coloured solution is obtained. Possible cations present in X are,

1. Cu^{2+} and Pb^{2+} (2) Zn^{2+} and Ba^{2+} (3) Al^{3+} and Zn^{2+}
4. Mn^{2+} and Pb^{2+} (5) Fe^{3+} and Pb^{2+}

(19) The IUPAC name of $K_4[Ni(CN)_4]$ is,

1. Potasium tetracyanidonickelate[IV]
2. Potasium tetracyanidonickel[IV]
3. Potassium tetracyanidonickel[0]
4. Potassium tetracyanidonickelate[0]
5. Potassiumtetracyanido nickelate[IV]

(20) 100.0 cm³ solution was prepared by dissolving 3.33g of $CaCl_2$ .100.0 cm³ of another solution was prepared by dissolving 4.92g of Na_3PO_4.The mass of $Ca_3(PO_4)_2$ that can be obtained theoretically when mixing these 2 solutions is

(Ca = 40 , Cl = 35.5 , Na =40 , P =31 , O= 16)

a. 135g (2) 2.7 g (3) 4.05g (4) 5.4g (5) 8.1g

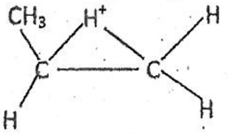
(21) Which of the following is correct for the first step of the mechanism of the addition reaction between CH_3CHCH_2 and H_2SO_4

(1) $CH_3-CH=CH_2 + H^{\delta+}-\overset{\delta-}{O}SO_3H \longrightarrow CH_3-\overset{+}{C}H-CH_3+\bar{O}SO_3H$

(2) $CH_3-CH=CH_2 + H^{\delta+}-\overset{\delta-}{O}SO_3H \longrightarrow CH_3-\overset{+}{C}H-CH_3+\bar{O}SO_3H$

(3) $CH_3-CH=CH_2 + H^{\delta+}-\overset{\delta-}{O}SO_3H \longrightarrow CH_3-CH_2-\overset{+}{C}H_2+\bar{O}SO_3H$

(4) $CH_3-CH=CH_2 + H^{\delta+}-\overset{\delta-}{O}SO_3H \longrightarrow$

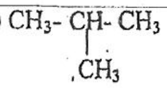


$+\bar{O}SO_3H$

(5) $CH_3-CH=CH_2 + H^{\delta+}-\overset{\delta-}{O}SO_3H \longrightarrow CH_3-\overset{+}{C}H-CH_3+\bar{O}SO_3H$

(22) The compound that form only one monobromo substituted compound is,

(1) $(CH_3)_3CH$ (2) C_2H_6 (3)



$CH_3-\underset{CH_3}{\underset{|}{CH}}-CH_3$

(4) CH_3-CH_2-CH_3 (5) None of above

(23) When a dilute NaOH is added drop wise to an aqueous solution of cation Y, a coloured precipitate is obtained. The precipitate react readily with atmosphere oxygen to form dark brown-black precipitate. Y can be

(1) Co^{2+} (2) Fe^{3+} (3) Mn^{2+} (4) Cu^{2+} (5) Cr^{3+}

(24) An oxide of pure X is heated with H_2 and passed through a catalyst , in an experiment conducted to find out the oxide of X. Oxide of X is completely converted to its hydride and water as follows

$$X_aO_b + H_2 \longrightarrow XH_6 + H_2O \text{ (not balanced)}$$

2479 cm³ volume of oxide at 25°C and 1 atm formed 9g water. Released hydride was reacted with dilute HCl with 2:1 molar ratio.100cm³ of 1.0 moldm⁻³ HCl was used. The oxide of X is , (The volume of 1 mole of oxide at 25°C and 1 atm is 24.79 dm³)

(1) XO (2) XO_2 (3) X_2O_3 (4)X_2O (5) X_2O_5

(25) 0.025mol $K_2CO_{3(s)}$ was added to 25.00cm³ of 4moldm⁻³ HCl solution at room temperature. The temperature of the solution was observed to increase by 10°C. The specific heat capacity of the resulting solution is 3000Jkg⁻¹K⁻¹ and density is 1000kgm⁻³.

The enthalpy of neutralization per mole of HCl reacted is,

(1) 20 kJmol⁻¹ (2) 6 kJmol⁻¹ (3) 5 kJmol⁻¹

(4) 15 kJmol⁻¹ (5) 10 kJmol⁻¹

(26) The molar fraction of an aqueous methanol (CH_3OH) solution is 4/5. The molality of the solution is,
(C= 12 , O= 16 , H=1)

(1) 0.2 $moldm^{-3}$
(2) 0.2 $molkg^{-1}$
(3) 9.6 $molkg^{-1}$
(4) 13.8 $molkg^{-1}$
(5) 13.8$moldm^{-3}$

(27) Consider the following statements with regards to decreasing the volume of a gas at constant temperature,
(a) The molar volume of the gas decreases,
(b) The mean speed of the gas molecules increases.
(c) The distance between gas molecules decreases
(d) Total collisions in unit volume increases.
Select the correct statement,

(1) Only a
(2) Only a and b
(3) Only a, b and c
(4) Only c and d
(5) Only a, c and d

(28) The mass of a mixture of Na_2CO_3 and $NaHCO_3$ is 22.0g.When this mixture reacts with excess HCl , 6.00l of CO_2 is produced. The temperature of the gas is 25°C and the pressure is 0.947 atm .The mass percentage of Na_2CO_3 is,

(1) 45%
(2) 55%
(3) 67%
(4) 60.5%
(5) 90%

(29) To determine the composition of IO_3^-, in a salt solution excess amount of KI and dilute H_2SO_4 were added to 100cm^3 of salt solution. The released I_2 was titrated with 0.005 $moldm^{-3}$ $S_2O_3^{2-}$ solution and the volume at the end point was 20 cm^3. The composition of IO_3^- in salt solution in ppm (M IO_3^- =175$gmol^{-1}$)

(1) 1.66
(2) 16.66
(3) 29.11
(4) 34.8
(5) 291.11

(30) Which of the following statement is true,
(1) The stable oxidation state of Sc is +2.
(2) The first ionization energy of d block elements are higher than that of s block elements in same period.
(3) According to electronic configuration of Cu^+ and Cu^{2+} , Cu^+ is most stable in aqueous solution.
(4) CrO_4^{2-} acts as an oxidizing agent in acidic medium.
(5) The reason for the colour of MnO_4^- ion is the electron transition between central manganese atom and ligand oxides.

- **Instructions for question no. 31 to 40.**

For each of the questions 31 to 40, four responses (a), (b), (c) and (d) are given. One or more of these is/are correct. Select the correct response / responses. In according to 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 (a) and (d) are correct
(5) If any other number or combination of response is correct

Summary of above Instruction.

(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/s is/are correct regarding the emission spectrum of atomic Hydrogen ?
(a) Electron transition between 4^{th} and 5^{th} energy levels are corresponding to the lowest frequency of Paschen series.
(b) H_α line represents the lowest frequency in the visible region.
(c) The lowest frequency of the electron transition of Blamer series is less than that of lowest frequency of Lyman series.
(d) Emission spectrum of H consists of main 4 series.

(32) Which of the following is/are true about hybridization,
(a) The energy of hybrid orbitals are same.
(b) A hybrid orbital can not be overlapped with non hybrid orbital.
(c) π bonds are formed by lateral overlapping of hybrid orbitals.
(d) The hybridization of Be atom in $BeCl_2$ and C atom in C_2H_2 is the same.

(33) Which of the following reacts with $BaCl_{2(aq)}$ to form a precipitate which dissolves in acidic medium ?
(a) $Ca(NO_3)_2$ (b) K_2CO_3 (c) Na_2SO_3 (d) Na_2SO_4

(34) Which of the following is/are true for C_4H_8O
(a) The total number of isomers are 7
(b) Number of optical isomers are 2
(c) Number of geometrical isomers are 2
(d) Number of isomers having less than 4 C in the main skeleton are 5

(35) Which of the following statement/s is/are true?
(a) $C_{(s)} + CO_{2(g)} \longrightarrow 2CO_{(g)}$ When the temperature increases the spontaneity of the reaction increases.
(b) $HCl_{(g)} \longrightarrow H_{(g)} + Cl_{(g)}$ Enthalpy change of the reaction is a positive value.
(c) The first ionization energy of $Na_{(g)}$ is required to calculate the value of lattice energy of $NaCl_{(s)}$ ionic compound.
(d) $2CO_{(g)} + O_{2(g)} \longrightarrow 2CO_{2(g)}$ The spontaneity of the reaction increases at high temperature.

(36) Which of the following compound react/s with tribromoethene to form an optically active compound.

(37) Which of the following statement/s is/are true for hydrogen peroxide?
(a) H_2O_2 can act as an acid and a base as it is amphoteric.
(b) The boiling point of H_2O_2 is higher than that of H_2O due to strong inter molecular interactions.
(c) H_2O_2 can react as an oxidizing agent as well as a reducing agent.
(d) All bonds in H_2O_2 are polar, so H_2O_2 possess dipole moment.

(38) Which of the following is/are false,
(a) The metallic bond strength of Mg is higher than the metallic bond strength of Ca.
(b) I_2 dissolves in KI better than water.
(c) Covalent compounds do not transmit electricity.
(d) Polarizability is higher in AgCl than AgI.

(39) Solution P consists of 2 cations and following experiments were carried out to identify the cations.

Experiment	Observation
I. Dilute NaOH is added dropwise	Non-white precipitate is obtained. No change in excess addtion.
II. (a)Dilute NH_4OH is added dropwise to the system observed in experiment(i)	(b) A coloured solution and a precipitate formed.
(b) The precipitate was filtered and separated	(c) The precipitate is white in colour.

The cations present in the solution P are,
(a) Ni^{2+} , Mg^{2+} (b) Co^{2+} , Zn^{2+} (c) Cu^{2+} , Al^{3+} (d) Ag^{+} , Ba^{2+}

(40) Which of the following is/are true for chlorination of $CHCl_3$ in diffuse sunlight?
(a) This is a electrophilic substitution reaction.
(b) This is a nucleophile substitution reaction.
(c) This is a free radical substitution reaction.
(d) Bonds are subjected to hemolytic cleavage.

- **Instructions for question no. 41 to 50.**

In question no. 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 appropriatly on your answer sheet.

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

	First statement	Second statement
41.	e/m ratio of positive rays does not change according to the gas inside a cathode ray tube.	Charge of the positive rays remains the same whatever the gas inside the cathode ray tube.
42.	The boiling point of NH_3 is higher than that of SbH_3	H bonds are present in NH_3
43.	When a mixture of $NH_4Cl_{(aq)}$ and $NH_4OH_{(aq)}$ added to $FeSO_{4(aq)}$ $Fe(OH)_2$will not get precipitated.	$Fe(OH)_{2(s)}$ dissolves in $NH_4OH_{(aq)}$
44.	Alkynes do not show substitute reactions	The characteristic reaction type of alkyne is electrophilic addition.
45.	What ever the temperature, the compressibility factor of He is always higher than 1.	He is a gas with very small atoms. It possess weak London dispersion forces.
46.	Fe^{3+} and Cr^{3+} form coloured precipitates when $(NH_4)_2S$ is added.	Fe^{3+} and Cr^{3+} are transition metal ions with unpaired electrons.
47.	The functional group of a given homologous series is the same	The physical and chemical properties of compounds in homologous series are same.
48.	The molarity of Mg^{2+} in a 2ppm Mg^{2+} solution is greater than the molarity of Na^+ in a 1ppm Na^+ solution.	When the molarity increases ppm levels of a certain cation solution increases
49.	The standard enthalpy of formation of any element at its most stable state is zero	The enthalpy of formation of $C_{(dimand)}$ is zero.
50.	$Cu^{2+}_{(aq)}$ and $Ni^{2+}_{(aq}$ ions can be separated and identified by adding Conc HCl to equivolume ion solution.	Conc HCl produce $[CuCl_4]^{2-}_{(aq}$ with $Cu^{2+}_{(aq)}$ and $[NiCl_4]^{2-}_{(aq)}$ with $Ni^{2+}_{(aq)}$

AL/2019/02-S-II(A)

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Co/ Vishakha Vidyalaya, Colombo 05

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, ජූලි 2019

General Certificate of Education (Adv. Level) Examination, 2019 July

රසායන විද්‍යාව II
Chemistry II

02 E II

පැය තුනයි
Three Hours

Grade : ....

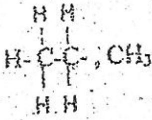
12 – ශ්‍රේණිය - 3 වන වාරය
Grade - 12 - 3rd Term Test

*Use of calculators is not allowed.

Universal gas constant	R	$= 8.314\ \text{J mol}^{-1}\ \text{K}^{-1}$
Avogadro constant	N_A	$= 6.022 \times 10^{23}\ \text{mol}^{-1}$
Plank's constant	h	$= 6.63 \times 10^{-34}\ \text{JS}$
Velocity of light	C	$= 3 \times 10^{8}\ \text{m S}^{-1}$
Faraday constant	F	$= 96500\ \text{Cmol}^{-1}$

Part A – Structured Essay (Pages 02 – 09.)

- Answer all the questions.
- Write your answer in the space provided below each question
- Please note that the space provided is sufficient for the answer and that extensive answers are not expected
- In answering questions you may represent alkyl groups in a condensed manner

eg:  , CH_3-CH_2-

$H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-$

Part B and Part C – Essay (Pages 11 - 16)

- Answer four questions selecting not more than two questions from each part.
- At the end of the time allocated for this paper, the answers to 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 Part B and C of the question paper from the Examination Hall.

Part	Q. Number	Marks
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
C	8	
	9	
	10	
Total		
Precentage		

Final Marks

In Number	
In Letter	

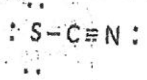
Do not write

Part A – Structured Essay

※ Answer all four questions. (each carries 10 marks)

1. (a) State whether following statements are true or false (Reasons are not required)

1. Ionic properties of NaCl is higher than that of CuCl. ( )
2. IF_3 is a non polar molecule. ( )
3. The most acceptable Lewis structure for thiocyanate $(SCN)^-$ is ( )

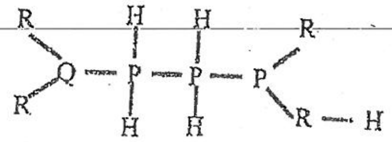


$:S-C\equiv N:$

4. The boiling point and melting point of NH_3 is greater than that of other hydrides of the same group. ( )
5. When an electron is expressed as quantum number (3 , 1 , 1, +1/2) it may has a dumbbell shape atomic orbital. ( )

(Marks 2.0)

(b) P , Q , R are consecutive elements belong to the 1st 20 elements in the periodic table. Their electro negativities vary as P<Q<R . Only P exsits as solid state in room temperature. P, Q , R bind with hydrogen to from a compound X , having $P_3QR_4H_5$ molecular formula. The skeleton of X is as follows



(x)

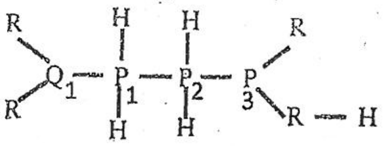
i. Identify the elements P, Q, R.

P- .... Q- .... R- ....

ii. Y is the stable anion of X. By using the skeleton of X and identified elements, draw the stable Lewis structure for Y.

iii. Draw 2 other resonance structures for Y.(except the structure drawn in part ii)

iv. Atoms of X are labeled as given below.



(ii)State following

I. VSEPR pair around atoms
II. Electron pair geometry around atoms
III. The shape around atoms
IV. Hybridization of atoms
Given in the table below by considering the stable Lewis structure drawn in part (ii)

	Q_1	P_1	P_3
I. VSEPR around the atom II. Electron pair geometry around the atom III. The shape around the atom IV. Hybridization of the atom			

v. State whether P_2 atom or P_3 atom in the stable Lewis structure drawn in part (ii) shows the higher electronegativity .Give reasons.

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(Marks6.0)

(c) Arrange the following in the increasing order of the property indicated in parenthesis. Reasons are not required.

I. $[Ni(CO)_4]$, $[Cu(CN)_4]^{3-}$, $[Co(NH_3)_6]^{3+}$(Number of non pair electrons in the central metal atom)

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

II. $MgCl_2$, NaCl , AgCl (boiling point)

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

III. S , P , N (covalent radius)

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

IV. NO_3^- , $\overset{+}{N}O_2$, NO_2 (O – N – O bond angle)

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(Marks2.0)

100

write

2. (a) X is an element belongs to the S block. Following are some chemical properties shown by X.

- Show green colour in flame test
- The hydroxide of X is water soluble and the sulphate of X is unstable.
- When heated in air it forms a mixture of three compounds A, B and C.

(i) Identify X.

....

(ii) Write the electronic configuration of stable cation of X.

....

(iii) Write chemical formulae for A, B and C

A- ....
B- ....
C- ....

(iv) Write down balanced chemical equations related in obtaining A, B and C.

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(v) Write down balanced chemical equations for following

(I) Thermal dissociation of bicarbonates of X

(II) Thermal dissociation of nitrates of X

(III) Thermal dissociation of hydroxides of X

(IV) The reaction between sulphite of X and dilute HCl

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(vi) Sodium salt of Y anion is added to a solution of chloride of X, a yellow precipitate is obtained. Identify Y.

....

(marks 4.8)

(b) 15g of a solid sample containing $KClO_3$, $BaCl_2$, NaOH and a thermally stable inert substance was heated to get a constant mass. The volume of gas evolved in this heating was 672 cm^3 at standard temperature and pressure. The residue after heating was dissolved in 250.0 cm^3 of water. Excess amount of K_2SO_4 is added to 25.0cm ^{3} of this solution and the mass of the precipitate obtained was 0.7 g. The filtrate was titrated with 1.5 moldm^{-3} HCl in the presence of phenolthalein and the volume of the end point was 6.0 cm^3.

(K= 39 , Ba = 137 , O = 16 , H =1 , Cl = 35.5 , S= 32 , Na = 23)

(i) Calculate the mass percentage of $KClO_3$ in solid sample ?

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Do not write

(ii) Calculate the mass of $BaCl_2$ in the solid sample .

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(iii) Calculate the mass of inert substance in the solid sample.

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(marks5.2)

3. (a) Explain enthalpy changes by considering given constituents.

(i) Standard enthalpy of atomization of iodine

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(ii) Standard enthalpy of second ionization of sodium.

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(II) (i) Following are some enthalpy changes for two reactions involve in manufacturing nitric acid. (reaction (1) and (2)). Calculate the enthalpy change of the reaction below by using data given for reaction (1) and (2) and some other reactions. ,

$$NO_{(g)} + \frac{1}{2}O_{2(g)} \longrightarrow NO_{2(g)}$$

Thermo chemical data

$$2NH_{3(g)} + \frac{5}{2}O_{2(g)} \longrightarrow 2NO_{(g)} + 3H_2O_{(g)} \quad \Delta H_R^\theta = -394\ kJmol^{-1} \longrightarrow (1)$$

$$\frac{1}{2}N_{2(g)} + O_{2(g)} \longrightarrow NO_{2(g)} \quad \Delta H_R^\theta = 33.0\ kJmol^{-1} \longrightarrow (2)$$

$$NH_{3(g)} \longrightarrow \frac{1}{2}N_{2(g)} + 3H_{2(g)} \quad \Delta H_R^\theta = 46.0\ kJmol^{-1}$$

$$H_2O_{(g)} \longrightarrow H_{2(g)} + \frac{1}{2}O_{2(g)} \quad \Delta H_R^\theta = 242\ kJmol^{-1}$$

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Do not write

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(ii) Find out the entropy changes of following equation using the data given.

$$NO_{(g)} + \frac{1}{2}O_{2(g)} \longrightarrow NO_{2(g)}$$

$\Delta S^{\theta}_{NO(g)} = 210.5\ Jmol^{-1}K^{-1}$

$\Delta S^{\theta}_{NO_2(g)} = 205.0\ Jmol^{-1}K^{-1}$

$\Delta S^{\theta}_{O_2(g)} = 240.0\ Jmol^{-1}K^{-1}$

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(iv)Deduce by calculation, whether the above reaction is spontaneous or not by using the calculated values of ΔH^{θ} and ΔS^{θ} at 300 K.

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(III) You have been provided $NaOH_{(s)}$, distilled water and 0.1 $moldm^{-3}$ and 0.2 $moldm^{-3}$ HCl solutions and other laboratory equipment. Explain the steps of an experiment to test the validity of Hess's law.

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(Marks 6.0)

(b) (I) Write down Dalton's partial pressure law. .

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(II) 0.02mol of N_2 gas and solid NH_4SH are present in a rigid closed bulb. The pressure of the bulb is 0.30×10^5 Pa at 27 ^{0}C . When this bulb is heated to 327^{0}C NH_4SH dissociate to $NH_{3(g)}$ and $H_2S_{(g)}$. The final pressure of the sample is 2.5×10^5 Pa .

(H= 1 , N= 14 , S= 32)

(i) Calculate the partial pressure of N_2 at 327 ^{0}C .

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(ii) Calculate the partial pressure of H_2S at 327 ^{0}C.

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(iii) Calculate the initial mass of NH_4SH present in the bulb.

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(iv) Write down assumptions you made in this calculation.

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100

(Marks 4.0)

4. (a) A, B and C are isomers of an organic compound with chemical formula C_6H_{10} . Following tests were carried out to identify the compounds.

A – Changes the direction of the plane of the polarized light. Gives white precipitate P when mixing with ammonical $AgNO_3$.

B- When mixing with Hg^{2+} / dilute H_2SO_4, product Q is obtained. IUPAC name for Q is 3,3-dimethylbutan-2-one.

D- When hydrogenating with Lindler catalyst, R is obtained. R shows geometrical isomerism. When R reacts with Br_2 /CCl_4, S is obtained. S molecule contains other substitute groups than Br.

(i) Identify the compounds A, B and C.

A	B	C

Do not write

(i) Draw the structures of P , Q and S

P

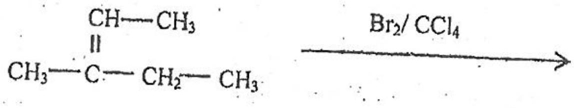
Q

S

(Marks 3.6)

(b) Write the main organic product as X and the IUPAC name as Y in the following reaction.

(i)

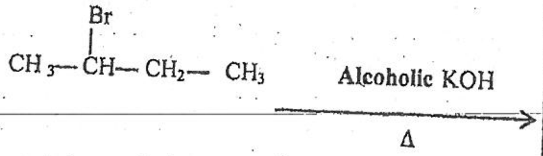


$$\mathrm{CH_3{-}\overset{\overset{\displaystyle CH{-}CH_3}{\|}}{C}{-}CH_2{-}CH_3 \xrightarrow{Br_2/\,CCl_4}}$$

(X)

(Y)

(ii)



$$\mathrm{CH_3{-}\overset{\overset{\displaystyle Br}{|}}{C}H{-}CH_2{-}CH_3 \xrightarrow[\Delta]{Alcoholic\ KOH}}$$

(X)

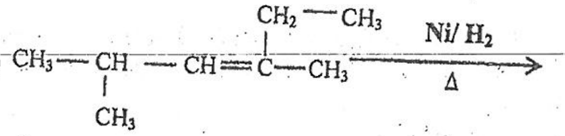
(Y)

(iii) $\mathrm{CH_3{-}CH_2{-}CH{=}CH_2 \xrightarrow[(ii)\ H_2O]{(i)\ Conc.\ H_2SO_4}}$

(X)

(Y)

(iv)



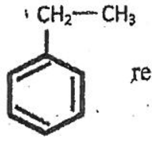
$$\mathrm{CH_3{-}\underset{\underset{\displaystyle CH_3}{|}}{C}H{-}CH{=}\overset{\overset{\displaystyle CH_2{-}CH_3}{|}}{C}{-}CH_3 \xrightarrow[\Delta]{Ni/\,H_2}}$$

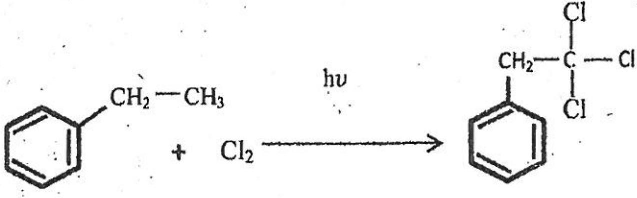
(X)

(Y)

(Marks 3.2)

Do not write

(c)  reacts with free radical(● Cl)and propagate to form A as follows.



(A)

Write down the mechanism for above reaction.

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(Marks 3.2)

Periodic Table

1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Aℓ	14 Si	15 P	16 S	17 Cℓ	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	La- Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tℓ	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	Ac- Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub	113 Uut	...				

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

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Co/Visakha Vidyalaya, Colombo - 05

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය 2019

General Certificate of Education (Adv. Level) Examination, 2019

රසායන විද්‍යාව II
Chemistry II

12– ශ්‍රේණිය Grade– 12

3 – වන වාරය 3rd Term Test
ජුලි - 2019 2019 - July

02 E II

✻ Universal gas constant $R = 8.314\ \mathrm{J\,mol^{-1}K^{-1}}$

✻ Avagardro constant $N_A = 6.022 \times 10^{23}\ \mathrm{mol^{-1}}$

Part B - Eassy

Answer two questions only (each carries 15 marks).

5. (a) Consider thermochemical data given below.

$\frac{1}{2}H_{2(g)} \longrightarrow H_{(g)}\ \Delta H^\theta = +218\ \mathrm{kJmol^{-1}}$

$\frac{1}{2}F_{2(g)} \longrightarrow F_{(g)}\ \Delta H^\theta = +79\ \mathrm{kJmol^{-1}}$

$\frac{1}{2}Cl_{2(g)} \longrightarrow Cl_{(g)}\ \Delta H^\theta = +122\ \mathrm{kJmol^{-1}}$

$C_{(s)} \longrightarrow C_{(g)}\ \Delta H^\theta = +717\ \mathrm{kJmol^{-1}}$

$\Delta H_D^\theta\ (C-H) = +415\ \mathrm{kJmol^{-1}}$

$\Delta H_D^\theta\ (C-F) = +485\ \mathrm{kJmol^{-1}}$

$\Delta H_D^\theta\ (C-Cl) = +328\ \mathrm{kJmol^{-1}}$

(i) Using relevant data, calculate standard formation enthalpy of following compounds by means of thermo chemical cycle only.

(I) $CF_3Cl_{(g)}$

(II) $CHF_2Cl_{(g)}$

(ii) When the formation enthalpy is a more negative value, normally compound is thermodynamically stable. According to this from above two compounds, which compound is more thermodynamically stable?

(iii) Both CF_3Cl and CHF_2Cl gases are green house gases and cause ozone layer depletion. If they form chlorine free radicals as in below reactions, calculate standard formation enthalpy of other haloakane radical.

(I) $CF_3Cl_{(g)} \longrightarrow CF_{3(g)} + Cl^{\cdot}_{(g)}$

(II) $CHF_2Cl_{(g)} \longrightarrow CHF_{2(g)} + Cl^{\cdot}_{(g)}$

(iv) Higher the negative values of standard enthalpy change of above reaction, formation of Cl radical is easy. $Cl^{\cdot}$ radicals cause ozone layer depletion. According to this, which gas, either CF_3Cl or CHF_2Cl is more harmful in ozone layer depletion.

(v) During ozone layer depletion $O_{3(g)}$ dessociates as in following

$O_{3(g)} \longrightarrow O_{2(g)} + O^{\cdot}_{(g)}$

Considering following thermochemical data predict the spontaneity of this reaction at 25°C

$\Delta H^\theta f\ (O_{3(g)}) = +143\ \mathrm{kJmol^{-1}}$

$\Delta H^\theta f\ (O_{(g)}) = +249\ \mathrm{kJmol^{-1}}$

$\Delta H^{\theta} f\ (O_{2(g)}) = 0\ kJmol^{-1}$

$S^{\theta}\ (O_{(g)}) = +239\ Jmol^{-1}K^{-1}$

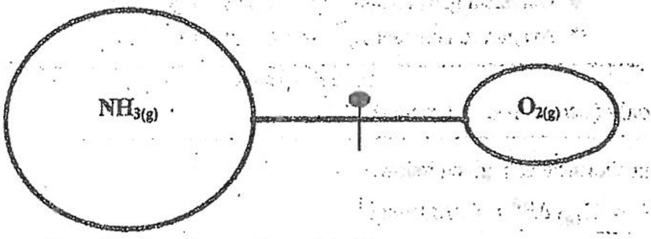
$S^{\theta}\ (O_{2(g)}) = +205\ Jmol^{-1}\ K^{-1}$

$S^{\theta}\ (O_{3(g)}) = +143\ Jmol^{-1}\ K^{-1}$

(Marks 8.0)

(b) A and B bulbs are connected via a tube and a tap as in below in which volume is negligible. Bulb A consists NH_3 gas and bulb B consists O_2 gas. The conditions of those are given below in same diagram.

T=27^{oC}
P= 3x10^5 pa
V=3.3256 dm^3



T=127^{0}C
P= 1x10^6 Pa
V=1.6628 dm^3

(i) Find the number of moles of gases in each bulb.

(ii) When tap was opened and the system was heated to 327^{0}C, NH_3 and O_2 gases reacted and form NO and H_2O. Once the reaction is over what is the pressure of the system at 327^{0}C ?

(iii) If the temperature of the system was reduced to 27^{0}C what is the new pressure.

(iv) What are the assumptions used in calculation.

6. (a) (i) Derive Avagadro law from the equation PV= nRT.

(b) A rigid vessel of 4.157 dm^3 consists a mixture of $NaHCO_{3(s)}$ and $(NH_4)_2CO_{3\ (s)}$. When heating the solution to 227°C , two compounds thermally dissociate completely. The pressure of the system reached to 6x10^4 Pa. Excess amount of HCl is added to the residue obtained after the reaction and the released gas was collected at 27°C .The volume of the gas was 1.6628 dm^3 at 3x10^3 Pa.(The volume of $NaHCO_{3(s)}$ and $(NH_4)_2CO_{3(s)}$ are negligible)

(N=14 , H=1 , O=16 , C= 12 , Na = 23)

(i) Write down balanced chemical equations for all chemical reactions.

(ii) Calculate the number of moles of $NaHCO_3$ and $(NH_4)_2CO_3$ in the mixture.

(iii) Calculate the mass percentage of $(NH_4)_2CO_3$ in the mixture.

(Marks 8.0)

(c) Write down balanced chemical equations for suitable chemical reactions at 298 K.

(i) Standard electron gaining enthalpy of Bromine $\Delta H^{\theta}_{EA} = -328\ kJmol^{-1}$

(ii) Standard enthalpy of atomization of Bromine $\Delta H^{\theta}_{at} = +112\ kJmol^{-1}$

(iii) Standard enthalpy of second ionization of calcium $\Delta H^{\theta}_{I_2} = 1150\ kJmol^{-1}$

(iv) Standard enthalpy of formation of Calcium Bromide $\Delta H^{\theta}_{f} = -683\ kJmol^{-1}$

(v) Standard enthalpy of bond dissociation of Bromine $\Delta H^{\theta}_{D} = +193\ kJmol^{-1}$

(vi) Standard enthalpy of atomization of Calcium $\Delta H^{\theta}_{at} = +177\ kJmol^{-1}$

(vii) Standard enthalpy of first ionization of Calcium $\Delta H^{\theta}_{I_1} = 590\ kJmol^{-1}$

(II) Calculate the standard lattice enthalpy of $CaBr_{2(s)}$ by using enthalpy diagram and using suitable data given above.

(Marks 7.0)

7. (a) (i) Explain how you would prepare an aqueous solution of tetrachloridocuprate(II) by using a copper wire in the laboratory. What is the colour of the solution? Write the balanced chemical equations.

(ii) Write down observations when the solution obtained in (i) was diluted and H_2S is passed through the solution.

(iii) Explain the observations when the solution in (i) was shaken with Cu coil when no air is inside the solution mixture.

(iv) Write down balanced chemical equations for above steps.

(Marks 5.0)

(b) $CuCl_2.xH_2O$ is thermally dissociate in to water vapour, chlorine gas and solid copper(I) chloride. The mass loss is 59%.

(Cu -63.5 , Cl – 35.5 , O= 16 , H = 1)

(i) Write down balanced chemical equations for above dissociation.

(ii) Calculate the value of X.

(iii) Write down observations when adding aqueous KI solution to above solution.

(Marks 4.0)

(c) X is a coordination compound with molecular formula $NiCl_2H_{10}O_5$ and with an octahedral geometry. X completely dissolves in water . 2.20 g of X is dissolved in water and dilute HNO_3 is added to acidify the solution. When excess amount of $AgNO_3$ is added . The mass of the precipitate obtained was 1.435g .

(Ni = 59 , O= 16 , H= 1 , Ag= 108 , Cl= 35.5)

(i) Deduce the chemical formular of X.

(ii) Draw the structure of the coordination complex of X.

(iii) Mention the colour changes when excess amount of NH_3 solution is added to the solution X.

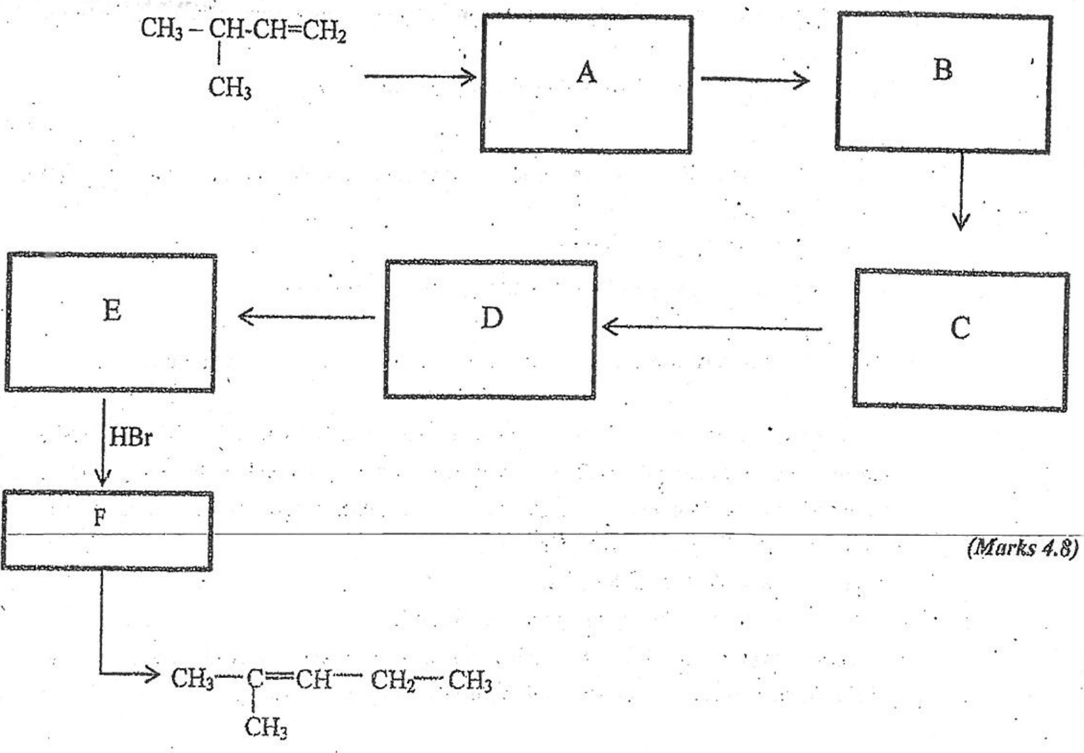
(iv) Write down balanced chemical equation for above reaction in part (iii)

(Marks 6.0)

Part C –Essay

Aswer two questions only. Each carries 15 marks.

8. (a) Consider the following sequence of reactions. Write the structures and reagents in blanks .



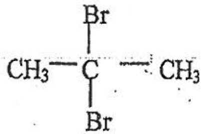
(Marks 4.8)

(b) Show how you would carryout the following conversion with minimum steps.

(i) $CH_3-C\equiv CH \longrightarrow CH_3-CH=CH-CH_2-CH_3$

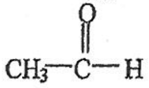
(ii) $CH_3-CH=CH_2 \longrightarrow CH_3-CH_2-CH_3$
(Note : Do not use catalytic hydrogenation)

(iii) $CH_2=CH-CH_3 \longrightarrow$



$CH_3-CBr_2-CH_3$

(iv) $CH_2=CH_2 \longrightarrow$



$CH_3-C(=O)-H$

(Marks 7.0)

(c) Consider the reaction between of $CH_3-CH=CH_2$ and HBr.
(i) Write down possible products of the reaction
(ii) What is the main product ?

(iii) Write down the mechanism related to formation of the main product.

(iv) Explain why the main product is more liable to form than the minor product.

(v) (I) Identify the nucleophile or electrophile for the reaction.

(II)State whether the above reaction is a nucleophilic substitution reaction , nucleophilic addition reaction , electrophilic substitution reaction, electrophilic addition reaction.

(Marks 3.2)

9. (a) X is a P block element in the periodic table.When X reacts with hot concentrated NaOH , it produces two salts A & B. When $Pb(NO_3)_{2(aq)}$ is added to aqueous solution a white precipitate is formed.When solid B is heated a colourless odourless gas C is formed. Reaction between X and water is a disproportination reaction and one product can decolourise coloured compounds.

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

(ii) Write balanced chemical equations for disproportionation reations out of all about observations.

(Marks 4.0)

(b). A solid sample was found to contain 3 water soluble salts, A ,B and C. The cation of these salts are same. Part of this sample was dissolved in water, to gain the solution S. Following 4 tests were carried out for solution S.

Experiment 1

To a portion of solution S excess amount of NaOH was added. The formed gas turns the phenolthalein solution to pink colour.

Experiment 2

To a portion of solution S, Al powder was added followed by excess of strong alkali solution and mixture was heated.The gas liberated turned Nessler reagent brown in colour.(when dilute acid is added to a portion of solution S, a brown gas was not observed)

Experiment 3

$BaCl_{2(aq)}$ was added to another portion of solution S. A white precipitate has formed and part of the precipitate dissolved in dilute HCl.

Experiment 4

To a portion of solution S, $CaCl_{2(aq)}$ was added. The formed precipitate was filtered and heated.The liberated gas turned lime water milky and it does not change the colour of the acidified $K_2Cr_2O_7$ solution.

(i) Identify the three salts in the solid sample

(ii) Write down balanced chemical equations for observations related to above 4 experiments.

(Marks 4.5)

(c) Bromate is considered as a carcinogenic compound. Following procedure was carried out to determine the composition of $KBrO_3$ in a solid sample. 0.8g of the solid sample was dissolved in 100 cm^3 of dilute acid with excess amount of KBr.(Following redox reaction takes place in the reaction mixture).

($BrO_3^- \longrightarrow Br_2$ and $Br^- \longrightarrow Br_2$)

Formed Br_2 then react with excess I^- added to the reaction mixture and then released I_2 was titrated with 0.05 $moldm^{-3}$ $Na_2S_2O_3$ solution , using starch as the indicater . The burette reading at the end point was 20.00cm^3 .Calculate the mass percentage of $KBrO_3$ in the sample. (K= 39 , Br = 80 , O= 16)

(Marks 6.5)

10. (a) Two aqeous solutions were tested separately for following experiments to identify X and Y metal cations.

Experiment	Observations	
	$X_{(aq)}$	$Y_{(aq)}$
(1) Adding NaOH	Blue precipitate (A)	Green precipitate (P)
(2) Adding excess NH_3	Deep Blue precipitate (B)	Blue solution (Q)
(3) Adding Conc HCl	Yellow solution (C)	Yellow solution (R)
(4) Adding H_2S	Black precipitate (D)	Black precipitate (S)

(i) Identify X and Y cations.

(ii) Write chemical formulae for precipitate A , D, P and S.

(iii) Write chemical formula complexes B,C,Q and R.

(iv) Name B,C, Q and R according to IUPAC nomenclature.

(b) 25.0cm^3 of 0.05 moldm^{-3} FeC_2O_4 was mixed with 25.00 cm^3 of $Fe_2(C_2O_4)_3$ in which the concentration is unknown. And the mixture was sufficiently acidified with H_2SO_4 and of 5 cm^3 H_3PO_4 was added and the mixture was titrated with 0.06 moldm^{-3} $KMnO_4$ solution.The burette reading at the end point, consider as X cm^3 .Another 25.00cm^3 of the above $Fe_2(C_2O_4)_3$ solution in which concentration is unknown was sufficiently acidified with H_2SO_4 acid and the mixture was titrated with 0.06 moldm^{-3} $KMnO_4$ solution. The burette reading at the end point was 10.00cm^3 . (Marks 7.5)

(i) Write balanced equations for reactions involved in above procedure.

(ii) Calculate the concentration of $Fe_2(C_2O_4)_3$ solution.

(iii) Find out reacted $KMnO_4$ volume X cm^3.

(Marks 7.5)

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