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අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය

General Certificate of Education (Adv. Level) Examination

රසායන විද්‍යාව I Chemistry I	02 S I	E04	පැය දෙකයි Two hours

- This paper consists of 8 pages. (Periodic table is provided.)
- 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
Second Term Test - 2019 April

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

(1) The mass of one atom of $^{120}_{50}X$ is

(1) 1.7×10^{-27} kg (2) 2.0×10^{-26} kg (3) 2.0×10^{-25} kg
(4) 0.5 kg (5) 1.2×10^{-3} kg

(2) The correct arrangement of ascending order of the second ionization energy of Al, Si , P, S and Cl is,

(1) Al<P <Si<S < Cl (2) Cl< S< P< Si< Al (3) Si< Al< P< S< Cl
(4) Al< Si<.S< P< Cl (5) Al< P< S< Si < Cl

(3) Element does not that form an ionic hydride with H_2 gas is,

(1) Li (2) Be (3) Na (4) Ca (5) K

(4) Two molecules of He and O_2 are moving at high speed. The speed of He is 4 times higher than the speed of O_2. The ratio of wavelengths of He and O_2 is, (O=16, He = 4)

(1) 1:1 (2) 2:1 (3) 1:2 (4) 3:4 (5) 4:3

(5) Select the correct enthalpy change and the symbol,

(1) $H_{2(g)} \rightarrow 2H_{(g)}$; $\Delta H^{\theta}_{atm(H_2(g))}$

(2) $Al^{3+}_{(g)} + aq \rightarrow Al^{3+}_{(aq)}$; $\Delta H^{\theta}_{sol(Al^{3+}(g))}$

(3) $Na_{(s)} \rightarrow Na^{+}_{(g)} + e$; $\Delta H^{\theta}_{I_1(Na(s))}$

(4) $H_{2\,(g)} + \frac{1}{2} O_{2\,(g)} \rightarrow H_2O(g)$; $\Delta H^{\theta}_{c(H_2O(g))}$

(5) $K_{(s)} \rightarrow K(g)$; $\Delta H^{\theta}_{atm(K(s))}$

(6) Mass percentage of HCl in an aqueous conc. HCl solution is 36%. The mass of HCl in 100g of this solution is,

(1) 50.2g (2) 56.25g (3) 36g (4) 54.5g (5) 102.8g

(7) The mass ratio of SO_2 and CH_4 gases in a gas cylinder is 1:2. The relationship of partial pressures of two gases is, (S=32, O=16, C=12 , H=1)

(1) $P_{SO_2} = P_{CH_4}$ (2) $P_{SO_2} = 2P_{CH_4}$ (3) $P_{SO_2} = 4P_{CH_4}$

(4) $P_{SO_2} = 6P_{CH_4}$ (5) $P_{SO_2} = 8P_{CH_4}$

(8) Which of the following statement is incorrect?

(1) Standard entropy value of H^+ ion of 1 $moldm^{-3}$ is considered to be zero at standard state.

(2) The properties that depend upon the amount of matter are named as extensive properties.

(3) The enthalpy change of a reaction is not independent of pressure.

(4) The enthalpy change that occur when 1 mol of ions under the standard state changes in to the solution form in the presence of an excess amount of water is called standard enthalpy of hydration.

(5) Entropy is an example for a state function.

(9) The density of 13.4 $moldm^{-3}$ ammonia solution is 0.91 g cm^{-3}. The composition of the solution in $mol\,kg^{-1}$ (N=14, H=1)

(1) 1.96 (2) 0.98 (3) 19.6 (4) 9.8 (5) 39.2

(10) The ratio of the root mean square speed of He and the root mean square speed of CH_4 is at same temperature (He-4, C-12, H - 1)

(1) 1:4 (2) 2:1 (3) 1:2 (4) 4:1 (5) 1:8

(11) Which of the following statement is incorrect about basicity of s block compounds?

(1) All hydroxides of alkaline metals are strongly basic.

(2) All oxides of alkaline earth metals are basic.

(3) All carbonates of alkaline metals are basic.

(4) All carbonates of alkaline metals react with dilute acids to form CO_2 gas.

(5) All hydroxides of alkaline metals react with ammonium salts to give a gas which turns red litmus in to blue.

(12) The ratio of $MgCO_3$ and $CaCO_3$ in a dolomite sample is 1:1. SiO_2 remains as an impurity. 2.0g of this sample is heated until to get a constant weight of 1.12g. The percentage of SiO_2 in the sample is, (Ca=40, Mg =24, Si=28, O=16)

(1) 5% (2) 6.5% (3) 6.9% (4) 7.2% (5) 8%

(13) Which of the following molecule is non polar?

(1) $SO_2C\ell_2$ (2) $CH_2C\ell_2$ (3) XeF_2 (4) IF_3 (5) SF_4

(14) 4 dm^3 volume of hydrogen gas container at 2×10^5 Nm^{-2} is connected with 2 dm^3 volume of nitrogen gas container at 3×10^5 Nm^{-2} pressure. The total pressure of the gas mixture is (No temperature change after mixing and gases are not reacting each other) (N=14, H=1)

(1) $2.5\times10^5\,Nm^{-2}$ (2) $2.8\times10^5\,Nm^{-2}$ (3) $3.0\times10^5\,Nm^{-2}$

(4) $3.2\times10^5\,Nm^{-2}$ (5) $4.3\times10^5\,Nm^{-2}$

(15) The substance which produce two products when heating is,

(1) Na_2CO_3 (2) $NaHCO_3$ (3) $NaNO_3$

(4) Na_2O (5) Na_2SO_4

(16) The combustion enthalpy for the following reaction at 298K is.

$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(\ell)$

$\Delta H_f^\theta(CO_2(g)) = -393 \text{ kJ mol}^{-1}$

$\Delta H_f^\theta(H_2O(\ell)) = -286 \text{ kJ mol}^{-1}$

$\Delta H_f^\theta(C_3H_8(\ell)) = +77 \text{ kJ mol}^{-1}$

(1) -756 kJmol^{-1} (2) −2246 kJmol^{-1} (3) −2390 kJmol^{-1}
(4) 756 kJmol^{-1} (5) 2246 kJmol^{-1}

(17) 2.68×10^{-3} moles of A^{n+} is present in a certain solution. 1.61×10^{-3} moles of $KMnO_4$ is needed to oxidise this ion to AO_3^-. The oxidation state of the cation is,

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

(18) Which of the following is true for BeH_2

(1) An ionic compound.
(2) The oxidation state of H is +1.
(3) Form $Be(OH)_2$ and water when react with water.
(4) Form a monomer in solid state.
(5) Hybridization of Be is sp.

(19) A product formed when heating crystalline sample of $(NH_4)_2Cr_2O_7$ rapidly,

(1) $NH_3(g)$ (2) $N_2O(g)$ (3) $Cr_2O_3(s)$ (4) $CrO_3(s)$ (5) $NO(g)$

(20) 250cm^3 of 0.0001mol dm^{-3} Zn^{2+}solution should be prepared by using a bottle containing $ZnSO_4$ and labelled as $3ZnSO_4.8H_2O$. The mass of the salt that should be weighted is,
(H=1 , O = 16 , S = 32 , Zn = 65.3)

(1) 6.22mg (2) 5.22 mg (3) 4.78 mg (4) 3.98 mg (5) 1.59 mg

(21) Which of the following reaction/s shows/show increase in entropy?

(a) $2NH_3(g) + 3C\ell_2(g) \rightarrow N_2(g) + 6HC\ell(g)$

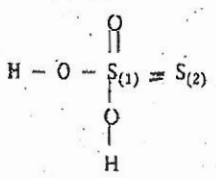
(b) $KC\ell O_4(s) \rightarrow KC\ell(s) + 2O_2(g)$

(c) $3Mg(s) + N_2(g) \rightarrow Mg_3N_2(s)$

(d) $CO(g) + H_2O(g) \rightarrow CO_2(g) + H_2(g)$

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

(22) Oxidation state of $S_{(1)}$ and $S_{(2)}$ of the following molecule is,



(1) + 6, 0 (2) + 4, 0 (3) + 6, -2 (4) + 4, -2 (5) + 2, +2

(23) 500cm^3 of gas A at 1000mmHg pressure and 500cm^3 of gas B at 2000mmHg pressure are introduced to a vessel of 3ℓ volume at same temperature. The final pressure of the vessel is.

(1) 500 mmHg (2) 650 mmHg (3) 1500 mmHg (4) 3000 mmHg (5) 5000 mmHg

(24) Which of the following is true about 2nd group elements in the periodic table?

(1) All chlorides are ionic.
(2) Thermal stability of carbonates decrease down the group.
(3) Water solubility of hydroxides increase down the group.
(4) Formed bicarbonates can be obtained in solid state.
(5) Metallic nitrite and oxygen are formed by thermal decomposition of metallic nitrates.

(25) The mass of solid residue when 2.68 g of $Na_2C_2O_4$ solution reacts with excess amount of $KMnO_4$ solution at basic medium. (Mn = 55, O = 16, C= 12 , Na= 23)

(1) 1.0 g (2) 1.12 g (3) 1.16 g (4) 2.61g (5) 1.74 g

(26) Certain reaction is spontaneous at 298 K and 80 kPa pressure. The reaction is nonspontaneous at high temperature and same pressure. Which of following is true?

	ΔG	ΔH	ΔS
(a)	+	−	−
(b)	−	+	+
(c)	+	+	+
(d)	−	−	−

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

(27) The composition of O_2 of an aqueous solution is 7.8ppm at room temperature. O_2 should be removed from this solution and O_2 can be removed by adding $Na_2SO_3(aq)$ and reaction is given below. (Na=23, S=32, O=16)

$Na_2SO_3(aq) + O_2(aq) \longrightarrow Na_2SO_4(aq)$ (Not balanced)

The amount of Na_2SO_4 formed when removing O_2 from 8.0 m^3 water sample, using Na_2SO_3 is, (Na=23, S=32 , O=16)

(1) 155.9 g (2) 175.8 g (3) 200.9 g (4) 311.9 g (5) 553.80 g

(28) The correct descending order of the solubility of following salts is,

(1) $BaSO_4 > SrSO_4 > CaSO_4 > MgSO_4$
(2) $BaSO_3 > CaSO_3 > MgSO_3 > BeSO_3$
(3) $Ba(OH)_2 > Mg(OH)_2 > Ca(OH)_2 > Be(OH)_2$
(4) $Ba(OH)_2 > Ca(OH)_2 > Mg(OH)_2 > Be(OH)_2$
(5) $BaSO_3 > MgSO_3 > CaSO_3 > BeSO_3$

(29) 40% (w/w) of propane is present in a mixture of propane (C_3H_8) and butane (C_4H_{10}). When the gas mixture is compressed to 1×10^6 Nm^{-2} pressure, the partial pressures of propane and butane are, ($\times10^5$ Nm^2) C= 12 , H= 1

(1) 3.4 and 5.3 (2) 3.4 and 5.6 (3) 4.5 and 6.2
(4) 4.7 and 6.4 (5) 4.8 and 7.2

(30) The correct ascending order of atomic radius of N, O, F, Si and Cl is,

(1) F < O < Si < N < Cl (2) F < O < N < Cl < Si (3) F < N < O < Si < Cl
(4) N < O < F < Si < Cl (5) F < O < N < Si < Cl

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

For each of the question 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 true about correct procedure when measuring the volume using a burette.

(a) The tip of the burette should be immersed in the required solution when adjusting the level of the liquid to "0" mark.
(b) The burette should be washed only with distilled water before use.
(c) The air bubbles in the liquid present inside the burette should be removed before adjusting the level of the liquid to "0" mark.
(d) It is not necessary to coincide the top level of the liquid to "0" mark always, before use.

(32) Compound/s which could be formed when a piece of Na is exposed to air?

(a) Na_2O (b) Na_2O_2 (c) Na_3N (d) Na_2CO_3

(33) Which of the following statement/s is /are true regarding the nature of the bond and the structure of ice?

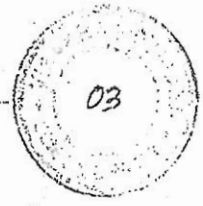
(a) H_2O molecules do not have kinetic energy.
(b) Bonds between two H_2O molecules are dipole-dipole interactions.
(c) The bond formed between O and H present inside the H_2O molecule is a H bond.
(d) O-H bond present inside a H_2O molecule is broken when ice get liquefied.

(34) The correct arrangement/s of the increasing order of bond angle is/ are,

(a) $CO_3^{2-} < SO_4^{2-} < NO_2^-$ (b) $PCl_3 < BCl_3 < SCl_2$
(c) $H_2O < CH_4 < SO_2$ (d) $H_3O < NO_2^- < NO_3^-$

(35) Which of the following statement/s is /are incorrect regarding $PV = \frac{1}{3}mNC^{\overline{2}}$ equation.

(a) Pressure of a gas is proportional to number of molecules present in unit volume at constant temperature.
(b) Mass of the gas can be obtained by mN
(c) $C^{\overline{2}}$ is the root mean square speed of the molecules of the gas.
(d) Total kinetic energy of molecules of the gas is equal to multiplication of PV.



(36) Concentration of an aqueous $CaSO_4$ solution is 1×10^{-3} moldm^{-3}. Correct statement/s about the solution is/are. (Ca= 40 , S=32 , O=16)

(a) concentration of the $CaSO_4$ solution is 40.0ppm

(b) concentration of the SO_4^{2-} solution is 96.0ppm

(c) concentration of the Ca^{2+} solution is 40.0ppm

(d) The mass of $CaSO_4$ in $1dm^{-3}$ of the solution is 136.0 g

(37) Which of the following statement/s is /are incorrect .

(a) The highest third ionization enthalpy in second period is for Be.

(b) Radii of Rb^+ is greater than the radii of Sr^{2+}

(c) All hydroxides which are formed by group one elements are thermally stable.

(d) All nitrides which are formed by first group metals are unstable.

(38) Which of the following statement/s is/are true about the compound formed by X in which atomic number is 33, reacting with hydrogen.

(a) It has formulae XH_3

(b) It's electron pair geometry is pyramidal.

(c) It's non polar.

(d) It's melting point is less than the melting point of NH_3

(39) Which of the following statement/s is /are correct,

(a) ΔS of a spontaneous reaction always has a positive value.

(b) Rate of a reaction increases when enthalpy difference of a reaction has a negative value.

(c) For an equilibrium reaction $\Delta G = 0$.

(d) When considering the forward reaction of an equilibrium reaction under constant temperature, it's ΔH and ΔS could be same.

(40) Which of the following statement/s is /are true?

(a) Electrons have particle nature as well as wave characteristics.

(b) Weight of a proton is less than that of a neutron.

(c) In every ion there is at least one electron.

(d) 3 types of subatomic particles proton, electron and neutron are present in every atom.

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.	H_α line has the highest wavelength of the visible region of Hydrogen emission spectrum.	The electron transition from third energy level to second energy level represented the H_δ line of the hydrogen emission spectrum.
42.	The spontaneity of a reaction can be increased by heating a chemical system.	When heating randomness of a system increases.
43.	The shapes of $CH_2C\ell^+$ and $CHC\ell_2^-$ are same.	The electron geometry of $CH_2C\ell^+$ and $CHC\ell_2^-$ species are same.
44.	The basicity of 1st group hydroxides increases down the group.	The electronegativity difference between the metal and O (M-OH) of hydroxides of first group increases down the group.
45.	$KMnO_4$ aqueous solution act as an oxidising agent in both basic and acidic medium.	The oxidizing ability of $KMnO_4$ depends on the medium.
46.	NH_3 does not act as an oxidizing agent.	N atom of NH_3 exists in the lowest oxidation state.
47.	Both Li and Mg form nitrides when reacting with nitrogen gas.	The strength of metallic lattice of Li and Mg are same.
48.	The $\frac{density}{pressure}$ ratio of an ideal gas at constant temperature does not depend on pressure.	Same numbers of molecules are present in same volume of gases in same temperature and pressure.
49.	Ideal gases do not obey Vander Waals equation.	There are corrections included in Vander Waals equation for real gases when they deviate from ideal conditions.
50.	Cl^+, $C\ell$ and $C\ell^-$ are isoprotonic species.	Cl^+, $C\ell$ and $C\ell^-$ species always have same number of neutrons.

Visakha Vidyalaya – Colombo 05

Second Term Test - April 2019
Grade –12

Chemistry II

Time : Two and half hours

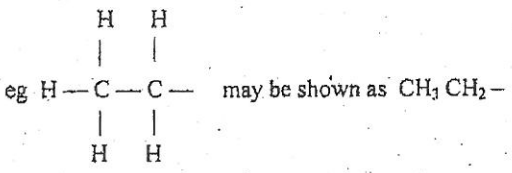
Name :- .....

Part A – Structured Essay (Pages 02 – 07)

*Use of calculators is not allowed.

* 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.

Alkyl groups are represented in a condensed manner.



Part B Essay (Pages 8-9)

* Answer all questions.
* At the end of the time allocated for this paper, bind the answers together so that part A is on top and hand them over to the supervisor.
* You are permitted to remove only Part B of the question paper from the Examination Hall.

Universal gas constant R		$=8.314\ J\ mol^{-1}\ K^{-1}$
Avogadro constant	N_A	$= 6.022 \times 10^{23}\ mol^{-1}$
Plank's constant	h	$= 6.626 \times 10^{-34}\ Js$
Velocity of light	C	$= 3 \times 10^{8}\ m\ s^{-1}$
Faraday constant	F	$= 96500\ C\ mol^{-1}$

For Examiner's Use only

Part	Q. NO.	Marks
A	1	
	2	
	3	
B	5	
	6	
	7	

Final Marks

In numbers	
In Letters	

VISAKHA VIDYALAYA 05

Part A - Structured Essay

* Answer all questions. Each carries 10 marks.

1. (a) A, B, C, D, E, F and G are seven consecutive elements which belong to the S and P blocks of the periodic table. Out of these two or more elements are in gaseous state. Their principle quantum numbers show consecutive numbers. The highest electronegativity is shown by element D and the minimum first ionisation energy is shown by element F.

(i) Write down chemical symbols for elements A to G.

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

D - ..... E - ..... F - .....

G - .....

(ii) Answer following by using real chemical symbols for above elements.

(a) The element which has the highest first ionization energy

.....

(b) The element / elements show allotropes

.....

(c) The element / elements which show the highest number of variable oxidation states.

.....

(d) The element which has the lowest electronegativity

.....

(e) The element which has the highest atomic radius

.....

(iii) (a) Write the chemical formula using real elements for the compound which is formed by elements G and C.

.....

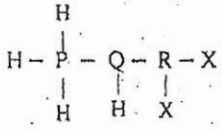
(b) Name the type of lattice present in the above compound.

.....

(3.2 marks)

(b) Answer following questions using the following skeleton A.

A



P, Q, R and X are not real symbols of elements and their principle quantum number is the same. P, Q, R and X could be same atoms or not. The electronegativity of element X is higher than the electronegativity of R.
The hybridization and shapes around P, Q, R elements are as follows.

atom	P	Q	R
hybridization	sp^3	sp^3	sp^2
shape	Tetrahedral	Pyramidal	Trigonal planer

(i) Identify elements for P. Q. R and X.

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

R ..... X.....

(ii) Draw the most acceptable Lewis structure for above skeleton with real symbols.

(iii) Draw two resonance structures for above Lewis structure (except the one drawn in part (ii))

(3.8 marks)

(c) State whether following statements are true or false. Give reasons.

(i) Ionic lattices are more liable to get dissolve in water while atomic lattices are not. (True / False)

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(ii) Hydrogen bond strength of HF is higher than that of water, but, the boiling point of HF is less than that of water. (True / False)

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(iii) Only London dispersion forces can be seen in HBr and H_2S. (True / False)

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(3.0 marks)

2. (a) X, Y and Z are non-transition consecutive elements in the same period. X reacts rapidly with cold water liberating gas A. The resultant solution B turns phenolphthalein to pink. Y does not react with cold water, but reacts with steam to produce gas A and product C.
Z does not react with hot water but reacts with NaOH and HCℓ to produce gas A.

(i) Identify elements X, Y and Z

X ..... Y .....

Z .....

(ii) Write down relevant balanced chemical equations for above observations of X, Y and Z

X .....

Y .....

Z .....

.....

(iii) Write down balanced chemical equations for reactions occur, when X is burnt in excess O_2.

.....

.....

(iv) When Y is burnt in air, product D and E are formed. D reacts with water to form a gas which turns Nessler reagent brown in color.

(a) Identify D and E.

D ..... E.....

(b) Write down balanced chemical equation for the reaction between D and water.

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(c) Comment on the acidic, basic and amphoteric properties of oxides of X, Y and Z.

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(d) Chloride of Z is an electron deficient compound. Explain

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(e) Explain whether decomposition temperatures of Nitrates of the group where Y belongs, increase or decrease down the group

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(7.0 marks)

(b) 56% of water and 17.5% of A by mass is present in an hydrated crystals of $ASO_4 . nH_2O$.
(S=32,O=16, H=1)

(i) Find the relative atomic mass of A.

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(ii) Calculate the mass percentage of oxygen in the compound.

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(3.0 marks)

3. (a) Following questions are based on an experiment conducted to determine the molar volume of oxygen by using $KMnO_4$.

Initial mass of the boiling tube	= 48.80 g
Final mass of the boiling tube	= 48.20 g
Volume of collected O_2	= 380 cm^3
Room temperature	= 27^0C
Atmospheric pressure	= 760 mmHg
Saturated vapour pressure of water at 27^0C	= 26.0 mmHg

(i) Write down balanced chemical equation for the decomposition of $KMnO_4$.

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(ii) Calculate the number of moles of O_2 produced.

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(iii). Calculate the volume of O_2 occupied by number of moles obtained in part (ii) at stp.

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(iv) Calculate molar volume of O_2.

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(v) Write down 2 errors that can be occurred in this experiment.

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..... *(5.0 marks)*

(b) (i) Define following enthalpies and write balanced equations.

a) Standard neutralization enthalpy for $NaOH_{(aq)}$

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b) Standard 1st electron gain enthalpy for $Cl_{2(g)}$

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c) Standard sublimation enthalpy for $Na_{(s)}$

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(ii) Answer following questions by using thermo chemical data in the table for following reaction.

$CS_{2(g)} + 4H_{2(g)} \rightarrow CH_{4(g)} + 2H_2S_{(g)}$

Compound	Standard formation enthalpy (ΔH_f^θ) kJ mol^{-1}	Standard entropy (ΔS^θ) J mol^{-1} K^{-1}
$CS_2(g)$	117	238
$H_2(g)$	0	130.6
$CH_4(g)$	−75	86
$H_2S(g)$	−20	206

(i) Find out ΔH^θ for above reaction at 25 ^{0}C.

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(ii) Find out ΔS^θ for above reaction at 25 ^{0}C.

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(iii) Predict the spontaneity of above reaction at 25 ^{0}C

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(5.0 marks)

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

රසායන විද්‍යාව II Chemistry II	Grade– 12 2nd Term Test	02	E II

* Universal gas constant R = 8.314 $Jmol^{-1}K^{-1}$
* Avogadro's constant N_A = 6.022×10^{23} mol^{-1}

Part B - Essay

- **Answer all questions. (Each carries 15 marks)**

4. (a) (i) State Dalton's law of partial pressure.

(ii) Derive Dalton's law from PV = nRT equation.

(iii) Venus's atmosphere is composed of 96.5% CO_2, 3.0% N_2, and 0.5% SO_2 by volume. It's atmospheric pressure is 9.0×10^6 Pa. Calculate the partial pressures of the gases.

(3.0 marks)

(b) (i) AB_3 (g) is exerted in a 2.00dm^3 volume container at 27 °C and 4.8×10^5 Nm^{-2} pressure. When heating to 127 °C AB_3(g) dissociated completely as following. Find the final pressure of the system.

$2\ AB_3\ (g) \longrightarrow AB_2(g) + AB_4(g)$

(ii) When the same initial container is heated to 327 °C AB_3 gas dissociated completely as following. Calculate the partial pressures of each component in the final mixture

$2\ AB_3\ (g) \longrightarrow A_2(g) + 3B_2(g)$ *(8.0 marks)*

(c) (i) What is meant by compressibility factor of a gas.

(ii) Draw the behavior of H_2 gas, CH_4 gas and C_2H_6 gas with respect to ideal gas in a graph against compressibility factor and pressure.

(iii) Explain their different behavior giving reasons.

(iv) In which conditions that real gases deviate from ideal behavior. Give reasons. *(4 marks)*

5. (a) (i) Deduce the shape of following ions.

1. N_3^- 2. CNO^- 3. NO_2^-

(ii) State the oxidation states of central atoms of above ions.

(b) (i) 5 mols of electrons are removed from 2.5 mols of hydroxyl amine (NH_2OH) to produce compound X. Moles of N in hydroxyl amine and compound X are same. Find the oxidation state of N in compound X.

(ii) Calculate the volume of 0.4 mol dm^{-3} $Na_2S_2O_3$(aq) solution which is reacted with iodine (I_2) released by the reaction between 50 cm^3 of 0.2 mol dm^{-3} $CuSO_4$(aq) solution and excess amount of KI in the acidic medium.

In acidic medium $Cu^{2+}_{(aq)} + I^-_{(aq)} \rightarrow Cu^+_{(aq)} + I_{2\,(aq)}$

$I_{2\,(aq)} + S_2O^{2-}_{3(aq)} \rightarrow I^-_{(aq)} + S_4O^{2-}_{6(aq)}$ equations are not balanced.

(5.0 marks)

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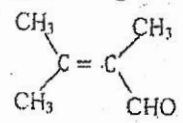
(c) (i) Consider the following reversible reaction.

$\frac{1}{2}A_2(g) + \frac{3}{2}B_2(g) \rightleftharpoons AB_3(g)\ ;\ \Delta H_R^\theta = -20\ kJ\ mol^{-1}$

Standard entropy values for $A_2(g)$, $B_2(g)$ and $AB_3(g)$ are 60, 40, 50 $J^{-1}\ mol^{-1}\ K^{-1}$ respectively. Find the temperature that the reaction reaches to its equilibrium.

(ii) Find the standard formation enthalpy for following organic compound which is a gas at 1 atm, by using following data.



$\Delta H_D^\theta (O=O) = 496\ kJmol^{-1}$
$\Delta H_D^\theta (C=O) = 743\ kJmol^{-1}$
$\Delta H_D^\theta (C-H) = 412\ kJmol^{-1}$
$\Delta H_D^\theta\ (C-C) = 348\ kJmol^{-1}$
$\Delta H_D^\theta\ (C=C) = 612\ kJmol^{-1}$
$\Delta H_{sub}^\theta\ (C, graphite) = 718\ kJmol^{-1}$
$\Delta H_{atm}^\theta\ (H_{2\,(g)}) = 218\ kJmol^{-1}$

(5.0 marks)

6. (a) When 16.8 g of compound X is heated, 4.4 g of gas A, 1.8 g of gas B and Y solid are formed. Gas A turns lime water milky and the solution become colourless when excess gas A is bubbled. Gas B turns anhydrous $CoCl_2$ in to blue. When solid Y dissolves in water and forms a basic solution. When adding excess amount of $BaCl_2(aq)$ to that basic solution white precipitate Z is formed. Z reacts with dilute acids to form gas A.

(C=12, O= 16 , H=1, S=32 , N=14 , Na= 23, K=39 , Ca=40 , Sr=88 , Mg = 24)

(i) Identify compound X by suitable calculation and explanation.
(ii) Write chemical formula for compounds A, B, Y and Z.
(iii) Write a chemical test to identify X and Y.
(iv) Write balanced chemical equations for following.
  I) Thermal decomposition of X.
  II) Gas A turns lime water milky.
  III) The milky solution becomes colorless when bubbling excess amount of gas A in lime water.

(7.5 marks)

(b) 5 test tubes are labelled from A to E and following compounds are introduced to those tubes. (Not in order)
$NaNO_3$, $Mg(NO_3)_2$, NH_4NO_3, NH_4NO_2, $LiNO_3$

When heating those compounds in tubes give following products.

Solid	Description of products
A	1. Polar colorless gas 2. water vapor
B	1. colorless gas 2.white solid which gives a colored gas with dilute acids
C	1. Nonpolar colorless gas 2. water vapor
D	1. Water soluble basic white solid 2. coloured gas 3. colourless gas
E	1. white solid which gives a precipitate with water. 2. Coloured gas 3. colourless gas

(i) Identify compounds A-E.
(ii) Write down balanced chemical equations for thermal decomposition of each compound.
(iii) Draw the most stable Lewis structures for gas A and gas C. *(7.5 marks)*