FWC

G.C.E. A/L Examination March - 2018

Conducted by Field Work Centre, Thondaimanaru
In Collaboration with
Provincial Department of Education, Northern Province.

Grade – 12 (2019)	Chemistry - II	Time :- 2 Hours

Part- II
Structured essay - A

❖ Answer all questions on This paper itself.

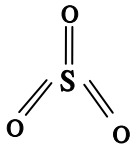
01.

a)

(i) To calculate the charge (Q) of an atom in a Lewis structure, fill in the cages in the expression given below with the proper symbols N_A, N_{LP}, N_{BP}.
Here,
N_A = Number of valence electrons in the atom.
N_{LP} = Number of electrons in the lone pairs.
N_{BP} = Number of electrons in the bonded pairs around the atom.

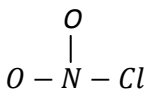
$Q =$ ☐ $-$ ☐ $- \ ^1/_2$ ☐

(ii) By substituting values of N_A, N_{LP} *and* N_{BP} in the proper cages, calculate charge of S, $Q_{(sulp\ hur)}$, in SO_3 the structure of which is given below.



$Q =$ ☐ $-$ ☐ $- \ ^1/_2$ ☐ $=$ ☐

(iii)

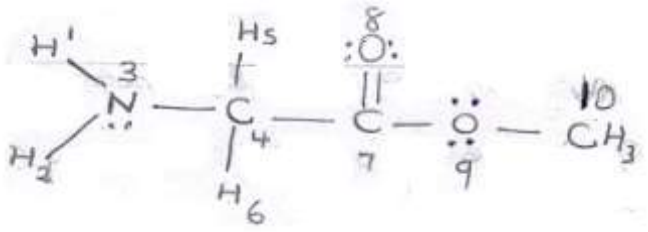


1. Draw the most acceptable Lewis structure for NO_2Cl molucule.

2. Draw three resonance stuctures for this for this molecule.

3. Indicate the unstable resonance structure and state reasons as to why this structure is unstable.

(iv) On the basis of the following Lewis structure, indicate the following for C, N, O atoms , in the table given below.



	N^3	C^4	C^7	O^9
1) Total number of electron pairs. 2) Geometry of electron pair. 3) Number of VSEPR pairs. 4) Shape 5) Hybridisation.				

(v) In the Lewis structure given in part (iv) above, identify the atom / hybrid orbitals related to the formation of 6 bonds.

I. $N^3 - C^4$ N^3 _____ C^4 _____

II. $C^4 - H^5$ C^4 _____ H^5 _____

III. $C^4 - C^7$ C^4 _____ C^7 _____

IV. $C^7 - O^9$ C^7 _____ O^9 _____

b) In I, II, III given below indentify the type/s of intermolecular forces.

I. aqueous Cl^-

II. O_2 dissolved in water .

III. I_2 dissolved in KI solution.

02. (a) A *and* B are elements belonging to the S block of the periodic table. Under normal conditions, A does not react with water, but reacts with hot water to from the hydroxide. At the same time under normal conditions B reacts with water to form the hydroxide. Hydroxide of B is more basic than that of A. Hydroxide of B is used to identify the gas (C) , which is responsible for global warming.

i. Identify A *and* B.

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

ii. Write the electronic configurations of A *and* B.

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

iii. Indicate the relative sizes for A *and* B for the following.

I. Size of atom ☐ > ☐ III. melting point ☐ > ☐

II. density ☐ > ☐ IV. first ionization energy ☐ > ☐

iv. Write the reactions that takes place when element B is burnt in atmosphere.

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v. One of the products obtained in the above part when dissolved in water and the product obtained can be used to identify the gas C, which is responsible for global warming. write balanced equation for the formation of that product.

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vi. Indentify gas C .

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vii. Write balanced equation for the reaction that takes place in the identification of C , using the product obtained in part (v)

(b) i. Complete the reactions given below by selecting suitable solutions from the list given below.

$NaCl_{(aq)}$, $Na_2SO_{3(aq)}$, $Pb(NO_3)_{2(aq)}$, $AgNO_{3(aq)}$, $HCl_{(aq)}$, $K_2SO_{3(aq)}$

Note :- One solution can be used more than once.

I. $AgNO_{3(aq)}$ + ☐ → A (White precipitate, which dissolves in dilute ammonia solution to produce clear solution)

II. $BaCl_{2(aq)}$ + ☐ → B (White precipitate, soluble in dilute ammonia solution producing clear solution)

III. $KI_{(aq)}$ + ☐ → C (Yellow precipitate, soluble in hot water)

IV. $NaOH_{(aq)}$ + ☐ → D (Ash colour precipitate soluble in excess ammonia solution)

V. $Na_2S_2O_{3(aq)}$ + ☐ → E (Yellow precipitate with yellowish turbiclity, insoluble in HCl)

VI. $Ba(NO_3)_{2(aq)}$ + ☐ → F (White precipitate, soluble in dilute HCl)

ii. Write the chemical formula of the precipitates from A to F.

A …… B …… C …… D …… E …… . F ……..

iii. In part b (i) above, write balanced equation for the dissolution of the precipitates A, C and F .

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03. (a). Volumes of flasks A, B are $3m^3$. Flask A contains He gas at $300K$ and $2 \times 10^5 Pa$ pressure. Flask B contains N_2 gas at $300K$ and $5 \times 10^5 Pa$ pressure. Both flasks are connected and allowed to mix completely. The temperature and total volume remains the same. Calculate the following assuming that the gases behave ideally.

i. Calculate the number of moles of He ?

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ii. What is the mole fraction of N_2 ?

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iii. Without changing the temperature of flask A if temperature of flask B is raised to $400K$, what will be the common pressure?

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(b) An alloy contains Mg and Al. When $5g$ of this alloy is dissolved in excess of H_2SO_4, $5.59dm^3$ H_2 was obtained. Assuming that the reaction is conducted at standard temperature and pressure. Calculate the mass percentage of Mg in the alloy. $(Mg - 24,\ Al - 27)$

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04. (a). Briefly explain the following.

i. Closed system.

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ii. Entropy

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iii. Gibbs energy

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(b). In the following changes, indicate whether the entropy increases / decreases.

i) $H_2O(l) \rightarrow H_2O_{(g)}$

ii) $(NH_2)_2\,CO_{3(s)} \rightarrow 2NH_{3(g)} + CO_{2(g)} + H_2O_{(g)}$

iii) $Mg_{(s)} + 2HCl_{(aq)} \rightarrow MgCl_{2(aq)} + H_{2(g)}$

iv) $2CH_{4(s)} + 2C_{(s)} \rightarrow 2C_2H_{4(g)}$

v) $K^+_{(g)} + Cl^-_{(g)} \rightarrow KCl_{(s)}$

(c). Consider the thermo chemical data at $25°C$ which is given below and the chemical reaction $CaCO_{3(s)} \longrightarrow CaO_{(s)} + CO_{2(g)}$.

Chemical species	$CaCO_{3(s)}$	$CaO_{(s)}$	$CO_{2(g)}$
Standard enthalpies of formation $kJmol^{-1}$	−1207	−635	−393
Standard entropy. ($J\ mol^{-1}K^{-1}$)	93	38	214

i) Calculate $\Delta H^{\emptyset}$ at $25°C$ for the above reaction.

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ii) Calculate $\Delta S^{\emptyset}$ at $25°C$ for the above reaction.

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iii) I. Write the expression for a chemical reaction that relates ΔG, ΔH and ΔS.

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II. Calculate $\Delta G^{\emptyset}$ for the above reaction at $25°C$.

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III. With reason mention about the spontaneity of the reaction.

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IV. Calculate the decomposition temperature of $CaCO_3$?

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V. What is the assumption you used in Part (iv) above?

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Part- II

Essay Question - B

❖ **Answer two questions only include question number five.**

05. a.

i) What do you understand by Ideal gas?

ii) Write the ideal gas equation and state what each of the terms represents.

iii) Obtain Boyles law from ideal gas equation.

b. The following experiment was done at room temperature in two (I, II) methods to calculate enthalpy of the reaction.

$NaHCO_{3(s)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)} + CO_{2(g)}$

Ex I To $100cm^3$ of $1mol\ dm^{-3}\ HCl$ in a beaker $0.05mol$ of $Na_2CO_{3(s)}$ was added and the temperature raised by $2.5K$

$[\ Na_2CO_{3(s)} + 2HCl_{(aq)} \rightarrow 2Na^+_{(aq)} + 2Cl^-_{(aq)} + H_2O_{(l)} + CO_{2(g)}\ ]$

Ex II It was found that during the complete decomposition of $0.5mol$ of $NaHCO_{3(s)}$, $20000J$ of heat was absorbed without loss of heat to the environment.

$[\ 2NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + H_2O_{(l)} + CO_{2(g)}\ ]$

Specific heat capacity and density of HCl solution are $10Jg^{-1}K^{-1}$ and $1gcm^{-3}$ respectively.

i) Calculate the enthalpy changes involved in procedures I and II above in $kJmol^{-1}$.

ii) Using the values obtained in part (i) above and a thermocycle calculate $\Delta H^{\emptyset}$ for the reaction. $NaHCO_{3(s)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)} + CO_{2(g)}$.

iii) In the Calculation in part (ii) above, a particular enthalpy change that takes place when $NaHCO_{3(s)}$ dissolves in $HCl_{(aq)}$ is neglected. Mention that change.

c. i. Draw the Born – Haber cycle for the formation of solid KCl.

ii. Using the data given below calculate lattice enthalpy, $\Delta H^{\emptyset}{}_L$ of $KCl_{(s)}$

Standard enthalpy of formation of $KCl_{(s)}$ $\Delta H^{\emptyset}{}_f = -437kJmol^{-1}$

Standard enthalpy of sublimation of $K_{(s)}$ $\Delta H^{\emptyset}{}_S = +89kJmol^{-1}$

Standard enthalpy of dissociation of $Cl_{2(g)}$ $\Delta H^{\emptyset}{}_D = +244kJmol^{-1}$

Standard first ionization enthalpy of $K_{(g)}$ $\Delta H^{\emptyset}{}_{I_1} = +418kJmol^{-1}$

Standard enthalpy of electron affinity of $Cl_{(g)}$ $\Delta H^{\emptyset}{}_{EA} = -349kJmol^{-1}$

06. (a). $1.6g$ of a sample containing only $SrCO_3$ and $BaCO_3$ was dissolved in excess of $50cm^3$ $0.8moldm^{-3}$ HCl. To neutralize the excess acid if $40cm^3$ of $0.5moldm^{-3}$ $NaOH$ solution was required. Calculate the mass percentages of $SrCO_3$ and $BaCO_3$.
(Sr – 88, Ba – 137, C – 12, O – 16)

(b). For the following write oxidation half reaction, reduction half reaction and balanced ionic equation.

1. Fe^{2+} / MnO_4^- ⟶
2. IO_3^- / I^- ⟶
3. H_2SO_3 / H_2S ⟶
4. Ag_2O / H_2O_2 ⟶
5. I^- / H_2O_2 ⟶

(c). M^{n+} ion of a 3d block element can be oxidized to MO^{2+} ion by $Cr_2O_7^{2-}$ in the presence of dilute H_2SO_4 In an experiment 20 cm^3 of $0.1moldm^{-3}$ $K_2Cr_2O_7$ was required to oxidize $4 \times 10^{-3}mol$ of M^{n+} to MO^{2+} Using these data calculate the value of n?

07. (a). When the nitrate B of $S-$ block element A was heated it decomposed to produce solid C, brown gas D and a colorless gas E. A reacted with water to produce gas F and solution G. Solid C dissolved in water and produced the same solution G. In flame test solid C showed red colour. The properties of element A was slightly different from the other elements in the group.

i) Identify the substances from A to G ?
ii) Write balanced equation for the reaction between element A and water.
iii) State a test to identify the gas F produced in the reaction in part (ii) above.

(b) Write balanced equations for that following reactions.

1. $LiNO_{3(s)} \xrightarrow{\triangle}$
2. $NaNO_{3(s)} \xrightarrow{\triangle}$
3. $Li_2CO_{3(s)} \xrightarrow{\triangle}$
4. $MgCO_{3(s)} \xrightarrow{\triangle}$
5. $CaCO_{3(s)} + H_2O_{(l)} + CO_{2(g)}$ ⟶