Provincial Department of Education - NWP

02	E	I

Second Term Test - Grade 12 - 2020

Index No : ..... Chemistry I Two Hours

Answer all the questions.

- **In each of the question 1 to 50 ,pick one of the alternatives from (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 =	6.022×10^{23} mol^{-1}
Plank's constant	h	= 6.626×10^{-34} J s	Velocity of light	c =	3×10^{8} m s^{-1}

1. Consider the following statements I and II.
   I - For degenerate orbitals, the lowest energy is attained when the number of electrons having the same spin is maximized.
   II - The same set of quantum numbers can not exist for the both electrons of any atom.
   The relevant rules given by the above statements I and II were stated by,
   1. Ernest Rutherford and Henry Becquerel
   2. Ernest Rutherford and Hund.
   3. Niels Bohr wolfgang Pauli
   4. Hund and wolfgang Pauli
   5. Hund and De Broglie

2. For an atom maximum number orbitals possible for the principle quantum number n = 4 is?
   1. 16 2. 14 3. 12 4. 9 5. 4

3. The number of resonance structures that can be drawn for nitronium ion. $[N^+O_2\ /\ (O-N-O)^+]$
   1. 2 2. 3 3. 4 4. 5 5. 6

4. What is the IUPAC name of FeC_2O_4?
   1. iron(II) carbonate
   2. iron carbonate
   3. iron(II) dicarbontetroxide
   4. iron(III) oxalate
   5. iron(II) oxalate

5. Select the pair of elements which shows the maximum electronegativity difference.
   1. C and P 2. C and N 3. Si and N 4. C and Si 5. B and Si

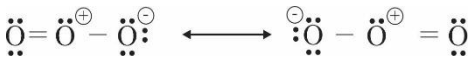
6. Consider the skeleton of the molecule $(NH_2)_2\,CO$ given below. ($H-N^1-C^2-N-H$)

$$\begin{array}{ccc} H & O & H \\ | & | & | \end{array}$$

The electron pair geometry and the shape around N^1 and C^2 atoms respectively are,

	N^1		C^2	
(1)	tetrahedral	Pyramidal	triangular planer	triangular planer
(2)	tetrahedral	Pyramidal	triangular planer	angular
(3)	Pyramidal	triangular planer	triangular planer	angular
(4)	triangular planer	Pyramidal	triangular planer	triangular planer
(5)	tetrahedral	Pyramidal	angular	triangular planer

7. What is the false statement regarding ozone?
   1. The central atom of ozone is sp^2 sybridized.
   2. The two bond lengths of ozone are identical.
   3. $O-O-O$ bond angle of ozone is smaller than 120^0.
   4. The resonance hybrid of ozone can be shown as follows.



   5. All oxygen atoms of ozone lay in the same plane.

8. MnO_2 reacts with conc. HCl to form $MnCl_2$, Cl_2 and H_2O . When 43.5 g of pure MnO_2 and 1.2 $mol\,HCl$ solution are subjected to react, the reactant consumed completely (i.e. the limiting reagent) and the amount of $Cl_2(g)$ formed respectively are.
($Mn = 55 gmol^{-1}$, $O =$ 16 $gmol^{-1}$, $H = 1g\,mol^{-1}$, $Cl = 35.5$)
   1. MnO_2 and 21.3 g
   2. HCl and 21.3 g
   3. MnO_2 and 35.5 g
   4. HCl and 35.5 g
   5. HCl and 85.2 g

9. The ideal gas equation can be mentioned as $P = CRT$ Here, C - concentration , P – pressure (pa) and T - temperature (K) . R is $J\,mol^{-1}K^{-1}$. The units of C of the above equation is,
   1. $mol\,cm^{-3}$
   2. $mmol\,dm^{-3}$
   3. $mmol\,m^{-3}$
   4. $mol\,dm^{-3}$
   5. $mol\,m^{-3}$

10. Select the decreasing order of melting points of the hydrides.
   1. HF > $H_2O > NH_3 > CH_4$
   2. $H_2O > HF > NH_3 > CH_4$
   3. $H_2O > NH_3 > HF > CH_4$
   4. $CH_4 > NH_3 > HF > H_2O$
   5. $HF > H_2O > CH_4 > NH_3$

11. What is the correct increasing order of the electronegativity of N atom in the species NH_2^- , NH_3 , NH_4^+ and NCl_3 ,
   1. $NH_2^- < NH_3 < NH_4^+ < NCl_3$
   2. $NH_2^- < NCl_3 < NH_3 < NH_4^+$
   3. $NH_2^- < NH_3 < NCl_3 < NH_4^+$
   4. $NH_4^+ < NH_3 < NCl_3 < NH_2^-$
   5. $NH_4^+ < NCl_3, NH_3, < NH_2^-$

12. The ratio between the root mean square speeds of H_2 and O_2 at 25^0C? $(H = 1, O = 16)$

1. $\frac{1}{4}$ 2. 16 3. $\frac{1}{16}$ 4. 4 5. 2

13. The products of the following reaction are,

$Mg(s)$ + conc. $HNO_3\ (aq) \rightarrow$ products

1. $Mg(NO_3)_2(aq) + NO_2(g) + H_2O\ (l)$
2. $Mg(NO_3)_2(aq) + NO(g) + H_2O(l)$
3. $Mg(NO_2)_2(aq) + NO_2(g) + H_2O\ (l)$
4. $Mg(NO_3)_2(aq) + H_2(g) + H_2O\ (l)$
5. $Mg(NO_3)_2(aq) + HNO_2(aq) + H_2O\ (l)$

14. Select the true statement.

1. The bond angle of H_2S is larger than the bond angle of H_2O.
2. The maximum number of σ bonds that can be formed by any element in group 15 is 5 .
3. All the elements of group 2 react with atmospheric N_2.
4. Li forms Li_2O_2 at the presence of excess O_2 gas.
5. The compounds of Al which have incomplete octets, form dimers in aqueous solutions.

15. Consider the following data at $298\ K$

$\frac{1}{2}\ N_2\ (g) + \frac{1}{2}\ O_2\ (g) \rightarrow NO(g)\ \ \Delta H^0 = 90.25\ kJ\ mol^{-1}$

$\frac{1}{2}\ N_2\ (g) + O_2\ (g) \rightarrow NO_2(g)\ \ \Delta H^0 = 33.18\ kJ\ mol^{-1}$

According to the above data, ΔH^θ of the reaction, $NO(g) + \frac{1}{2}O_2(g) \rightarrow NO_2(g)$ is,

1. $-57.07\ kJmol^{-1}$
2. $57.07\ kJmol^{-1}$
3. $123.43\ kJmol^{-1}$
4. $-123.43\ kJmol^{-1}$
5. $23.89\ kJmol^{-1}$

16. The following equilibrium is established in the vaporization of the liquid A

A(l) $\rightleftharpoons$ $A(g)$

The enthalpy change and the entropy change of this vaporization are $44.76\ kJ\ mol^{-1}$ and $120.0\ J\ K^{-1}\ mol^{-1}$ respectively. The boiling point of that liquid is,

1. $493\ ^0C$ 2. $275.6\ ^0C$ 3. $-272.6\ ^0C$ 4. $373\ ^0C$ 5. $100\ ^0C$

17. What is the false statement regarding the allotropic forms of Carbon (C)?

1. Both diamond and graphite consist of homo atomic lattice structures.
2. Graphite is a good conductor of electricity as well as heat.
3. Graphite is a three dimensional lattice and its C atoms are sp^2 hybridized.
4. C- C bond length of graphite is less than C - C bond length of diamond.
5. C atoms of fullerene are connected each other spherically.

18. At a certain temperature $SO_2(g)$ reacts with, $O_2(g)$ and forms only $SO_3(g)$ At the relevent temperature and the constant pressure when $8\ dm^3$ of $SO_2(g)$ and $10\ dm^3$ are reacted, the final volume of the mixture is,

1. $18\ dm^3$ 2. $10\ dm^3$ 3. $20\ dm^3$ 4. $14\ dm^3$ 5. $13\ dm^3$

19. A mixture of $A(g)$ and $D(g)$ are placed in an evacuated rigid vessel at the temperature of T. At this temperature both $A(g)$ and $D(g)$ decompose according to the following reactions.

$2A\,(g) \rightarrow B(g) + 3\,C(g)$

$D(g) \longrightarrow B(g) + 2\,C\,(g)$

The initial pressure P of the vessel is changed up to $2.7P$ after the complete decomposition of the two reactants. At that temperature the ratio between the initial partial pressures of $A(g)$ and $D(g)$ is,

1. 2 / 1 2. $\frac{10}{3}$ 3. $\frac{1}{27}$ 4. $\frac{3}{10}$ 5. $\frac{3}{7}$

20. Which of the followings gives a blue violet colour to the flame test?

21. 1. $LiCl$ 2. $NaCl$ 3. $CaCl_2$ 4. $CsCl$ 5. KCl

21. In acidic medium to oxidise $25\,cm^3$ of H_2O_2 solution, $20\,cm^3$ of $0.1\,mol\,dm^{-3}$ $KMnO_4$ is required. The concentration of H_2O_2 is,

$(MnO_4^- \rightarrow Mn^{2+}\ ,\ H_2O_2 \rightarrow O_2)$

1. $0.08\,mol\,dm^{-3}$ 2. $0.2\,mol\,dm^{-3}$ 3. $0.016\,mol\,dm^{-3}$
4. $0.125\,mol\,dm^{-3}$ 5. $0.4\,mol\,dm^{-3}$

22. Consider the following molecules.

$NF_3\ , CF_2Cl_2\ , OCl_2$

When H atoms are substituted instead of the other atoms around the central atoms of all the above molecules, the oxidation number of the central atom of the each molecule respectively is,

1. increasing, not changing, decreasing.
2. not changing, not changing, changing
3. decreasing, increasing, not changing
4. decreasing, decreasing, not changing
5. decreasing, decreasing, increasing

23. Select the incorrect statement.

1. The basicity of $NaOH$ is greater than the basicity of $Mg(OH)_2$.
2. When going down the first group the covalent nature of the hydroxide are increasing.
3. The water solubility of NaI is greater than $NaCl$
4. The hydroxide of Al reacts with bases.
5. The hydroxide of Al reacts with acids.

24. The concentration of a certain $NaCl$ solution is 1×10^{-3} mol dm^{-3} . The composition of it in ppm is.

$(Na = 23\ , Cl = 35.5)$ $(1\,ppm = 1\,mg\,dm^{-3})$

1. 58.5×10^{-3} 2. 0.585 3. 5.85 4. 58.5 5. 585

25. A solution prepared by dissolving $1g$ of a sample containing KIO_3 is treated with an acidic solution containing excess KI. The released iodine is reacted with $0.003\,mol\,dm^{-3}$ $Na_2S_2O_3$ solution. The required volume of $Na_2S_2O_3$ is $25\,cm^3$. The mass percentage of KIO_3 present in the sample is, $(KIO_3 = 214)$

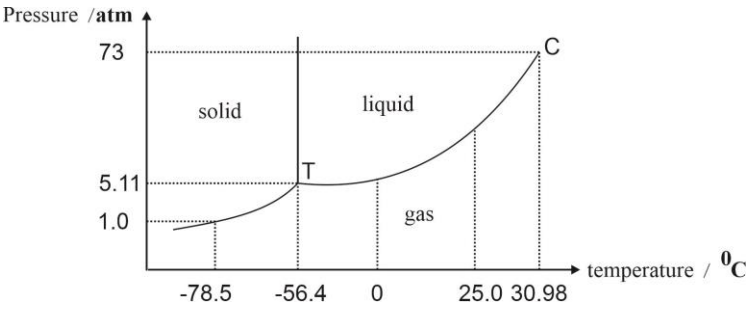
$H^+ / IO_3^- \rightarrow I_2\ ,\quad I^- \rightarrow I_2$ and $S_2O_3^{2-} + I_2 \rightarrow S_4O_6^{2-} + I^-$

1. 1.605×10^{-2} 2. 1.605 3. 3.21 4. 2.675×10^{-3} 5. 2.675×10^{-1}

26. Select the reaction step which does not include in the Born -Haber cycle relevant to the formation of $MgO\ (s)$.

1. $Mg(s) \rightarrow Mg(g)$
2. $\frac{1}{2}\ O_2(g) \rightarrow O(g)$
3. $Mg^{2+}(aq) + O^{2-}(aq) \rightarrow MgO\ (s)$
4. $O(g) + e \rightarrow O^{-}\ (g)$
5. $\mathrm{Mg(s)} + \frac{1}{2}\ O_2(g) \rightarrow MgO(s)$

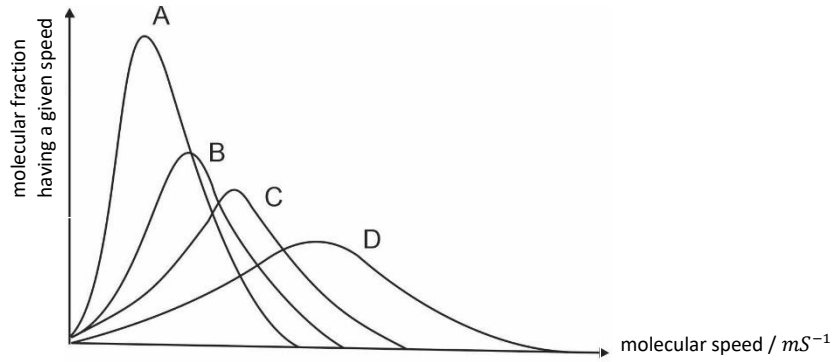
27. Phase diagram of CO_2 is given below.



The critical temperature of CO_2 is,

1. $30.98^0\ C$
2. $25.0^0\ C$
3. $0^0\ C$
4. $-56.4^0\ C$
5. $-78.5^0\ C$

28. At $300K$, Maxwell - Boltzmann speed distribution of four gases is given below.



These A, B, C, D gases respectively are,

1. $H_2(g),\ \ N_2(g)\ ,\ O_2(g)\ , Cl_2(g)$
2. $Cl_2(g),\ \ O_2(g)\ ,\ N_2(g)\ , H_2(g)$
3. $H_2(g),\ \ N_2(g)\ ,\ Cl_2(g)\ , O_2(g)$
4. $H_2(g),\ \ Cl_2(g)\ ,\ N_2(g)\ ,\ O_2(g)$
5. $O_2(g)\ ,\ Cl_2(g),\ N_2(g)\ , H_2(g)$

29. Which of the followings is correct regarding the variation of the electron gaining enthalpy of the elements present in second and third periods?

1. The enthalpy change that occurs when a mole of electrons are gained by a mole of gaseous molecules in standard state to form a mole of uni negative ions in standard state.
2. Since F is highly electronegative, it has the highest electron gaining enthalpy.
3. Cl has the highest electron gaining enthalpy.
4. This is identified as electron affinity.
5. Since the elements such as Mg has a halfly filled stable electron configuration the electron gaining enthalpy is a negative value.

30. Which of the following statements is correct?
    1. If the whole thermochemical equation is multiplied by a certain number, the enthalpy change also should be multiplied by the same number.
    2. The unit of the enthalpy change of a reaction is changed according to the number of moles participated for the reaction.
    3. When a reaction is reversed both the sign of ΔH and its magnitude are changed.
    4. The value of ΔH is not changed on the physical state of the reactant and products.
    5. If the sign of ΔH^{θ} is negative then the reaction is endothermic.

- **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/ s is / are correct regarding the compounds formed by the elements of s block ?
    (a) All bicarbonate (Hydrogen Carbonate) are available in solid state.
    (b) $LiHCO_3$ is not available in solid state.
    (c) All the carbonates of second group are thermally unstable.
    (d) When $NaNO_3$ is objected to thermal decomposition , $NO_2(g)$ can be obtained.

32. Which of the following statements is / are correct?
    a) Enthalpy is a state function and an extensive property.
    b) Heat is not a state function and an extensive property.
    c) Density is an extensive property.
    d) Molar enthalpy is a state function and an intensive property.

33. The correct equation and the relevant enthalpy change is / are mentioned in,
    (a) The standard enthalpy of atomization, $Cl_2(g) \rightarrow 2Cl\ (g)$
    (b) The standard enthalpy of solution $NaCl\ (aq) \rightarrow NaCl(s) + water$
    (c) The standard enthalpy of neutralization $H^+(aq) + OH^-(aq) \rightarrow H_2O\ (l)$
    (d) The standard enthalpy of fusion $Al\ (s) \rightarrow Al\ (l)$

34. Among the following reactions the correct reaction / reactions is/ are ?

(a) $2\,Na\,(s) + H_2(g) \rightarrow 2\,NaH\,(s)$

(b) $6\,Na(s) + N_2(g) \rightarrow 2\,Na_3N\,(s)$

(c) $4\,NaNO_3(s) \rightarrow 2\,Na_2O\,(s) + 4NO_2(g) + O_2(g)$

(d) $2\,LiNO_3(s) \rightarrow 2LiNO_2\,(s) + O_2(g)$

35. Which is / are correct regarding the solubility of the salts of the second group?

(a) Except $BeCO_3$ all the carbonates are insoluble.

(b) All the sulphates are insoluble.

(c) When going down the group the solubility of sulphates is decreasing.

(d) All the nitrates are soluble.

36. Select the extensive property / properties.

(a) volume (b) amount of moles (c) Temperature (d) molar volume

37. Which of the following statements is / are correct regarding the electromagnetic radiation?

(a) Travel in the velocity of light through the vacuum.

(b) The oscillation of the electric and magnetic fields of them are parallel to the direction of the waves.

(c) The various electromagnetic radiations are differed each other since their speeds are different each other.

(d) These are periodic.

38. Select the modecule/s which is / are containing all covalent ionic and dative bonds.

(a) $NaNO_2$ (b) $NaNO_3$ (c) $(NH_4)_2CO_3$ (d) NH_3BF_3

39. Which of the followings is / are true for the thermochemical equation given below.

$2\,H_2\,(g) + O_2(g) \rightarrow 2\,H_2O(g), \quad \Delta H^\theta = -483.7\,kJ\,mol^{-1}$

(a) 483.7 kJ is released per one mole of reaction.

(b) 483.7 kJ is released per two moles of consumed $H_2(g)$.

(c) 483.7 kJ is released per one mole of consumed $H_2(g)$.

(d) 483.7 kJ is released per one mole of water vapours formed.

40. Select the correct statement /s regarding the metallic bonds.

(a) When the positive ions become large the electron density of the metallic bond is increasing.

(b) The cloud of mobile electrons are moving steadily all over the lattice to stabilize the lattice.

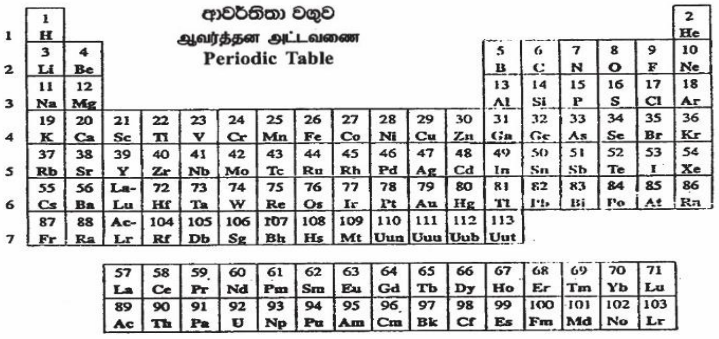
(c) When the number of electrons provided by an atom is increasing then the metallic bond strength is increasing.

(d) The ionic nature of alkali metals and alkaline earth metals is affected highly for the metallic bonds.

- **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 explains the 1st statement correctly	1
True	True but does not explain the first statement correctly	2
True	False	3
False	True	4
False	False	5

	First statement	Second statement
41.	The boiling point of ICl is greater than Br_2.	Br_2 is a non-polar molecule. ICl is a polar molecule. Therefore dipole dipole attractions are existing.
42.	cathode rays are deflected towards the magnetic poles at the presence of a magnetic field.	Cathode rays are negatively charged .
43.	Wave length of the first line of the Balmer series is longer than the wave length of the first line of the Lymann Series.	When lymann and Balmer series are considered Lyman series belongs to a region with higher wave lengths.
44.	Across a same period left to right shielding effect is increasing due to the increasing of number of electrons.	When going from left to right in the same period the effective nuclear charge is decreasing, because the atomic radius is decreasing.
45.	Valence shell electrons participate for the chemical bond formations.	Covalent bonds are formed by sharing the electrons.
46.	In a balanced chemical equation, the number of molecules and the charges of both sides should be equal.	The masses of the both sides of a balanced chemical equation should be equal.
47.	Liquid takes the shape of its container but it does not spread all over the container.	The shape of liquid depends on the gravitational force.
48.	Volumetric flasks are used for the preparations of the solutions with a known concentration.	In dilution of an acid, water is added to a known volume of an acid.
49.	The enthalpy of neutralization of strong acids and strong bases is constant.	The enthalpy of neutralization of weak acids and weak bases is quite different than that of the strong acids and strong bases.
50.	*s* block elements acts as reducing agents.	Under certain conditions, the metals of the group *I* of *s* block undergo reduction by gaining electrons.



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Provincial Department of Education - NWP

02 | E | II

Second Term Test - Grade 12 - 2020

Index No : ....

Chemistry II

Three Hours

※ *A Periodic Table is provided*

※ ***Use of calculators is not allowed.***

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

※ *Avogadro constant,* $N_A = 6.022 \times 10^{23}\ mol^{-1}$

Plank's constant h = 6.626×10^{-34} J s

Velocity of light c = 3×10^{8} m s^{-1}

❑ **PART A — Structured Essay**

※ *Answer **all** the questions on the question paper itself.*

※ *Write your answer in the space provided for each question. Please note that the space provided is sufficient for the answer and that extensive answers are not expected.*

❑ **PART B and PART C — Essay**

※ *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		
Percentage		

Final Mark

In Numbers	
In Letters	

Code Numbers

Examiner	
Checked by	1
	2
Supervised by	

Part - A – Structured Essay

(01) a. I. The following questions are relevant to the elements of the third period of the periodic table. When answering part (i) to (vi) write the symbol of the element in the blanks given below.

i. Identify the least electronegative element. (Ignore the noble gas.)

.....

ii. Identify the uni atomic ion with the smallest size. (This ion should be stable.)

.....

iii. Identify the element which has a stable configuration although it does not have P electrons.

.....

iv. Identify the element which has highest first ionization energy secondly.

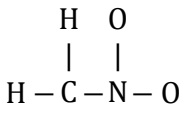
.....

v. Identify the element which forms electron deficient compounds and existing as dimers in gaseous state.

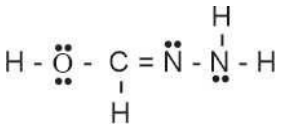
.....

(b) Draw the most acceptable Lewis dot - dash structure can be drawn for the ion $CH_2NO_2^-$. The Skelton of it is given below.

I.

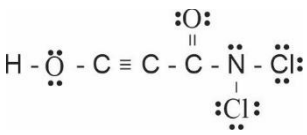


II. The most acceptable lewis dot - dash structure for the molecule H_3CN_2O is given below. Draw another two Lewis dot - dash structures. Write as 'unstable' under the most unstable structure which is drawn by you.

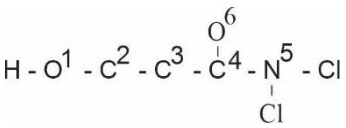


III. By considering the Lewis dot dash structure given below mention the followings for the atoms C, N and O ,

i. $VSEPR$ pairs around atoms.
ii. The electron pair geometry around the atom.
iii. shape around the atom.
iv. Mention the hybridization of the atoms.
v. Mention the oxidation number of the atoms.



Atoms are numbered as follows.



	O^1	C^2	C^3	N^5
$VSEPR$ pairs				
Electron pair geometry				
shape				
Hybridization				
Oxidation Number				

IV. Identify the atomic / hybrid orbitals which are participated to form the following σ bonds, present in the Lewis dot dash structure of part (iii) above. [The numbering of the atoms is the same as in part (iii)]

I. $H - O^1$ H ……… O^1 ……

II. $O^1 - C^2$ O^1 ……… C^2 ……

III. $C^2 - C^3$ C^2 ……… C^3 ……

IV. $C^3 - C^4$ C^3 ……… C^4 ……

Vi. $C^4 - N^5$ C^4 ……… N^5 ……

Vi. $C^4 - O$ C^4 ……… O ……

V. Identify the atomic orbitals which are participated for the formation of the following π bonds present in the Lewis dot - dash structure given in above (iii) [The numbering of the atoms is the same as in the above (iii)]

I. $C^2 - C^3$ C^2 ..... C^3 .....

II. $C^4 - O^6$ C^4 ..... O^6 .....

VI. i. What is the orientation of the two π bonds in the triple bond of the Lewis dot dash structure in part (iii) above.

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ii. Give an example for a molecule / an ion which is having a triple bond between 2 different atoms.

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N.B. - Your example should not contain more than 3 atoms. The element present in your example should be limited to first and second periods of the periodic table.

(c) i. The atomic orbitals are described by the 3 quantum number n , l and m_l. Write the relevant quantum number and the name of the atomic orbital in the cages, given below.

1. ☐ ☐ -1 $4P$

2. 4 2 0 ☐

3. ☐ ☐ ☐ $3s$

ii. Arrange the following in to the increasing order of the property mentioned inside the parenthesis is,

I. $BeCO_3$, $MgCO_3$, $CaCO_3$ (decomposition temperature)

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

II. N^+O_2 , NO_2 , NO_2^- ($O\hat{N}O$ bond angle)

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

III. C_2H_6 , C_2H_4 , C_2H_2 ($C - C$ bond length)

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

(02) a. X is an element of $S-$ block in the periodic table. The first second and third ionization energies of X are $519, 7300, 11800$ in $kJ\ mol^{-1}$ respectively. X occurs a reaction which is not strong with water forming its hydroxides and liberating $H_2(g)$. The hydroxide is basic. When X reacts with dilute acids, $H_2(g)$ gas is released. X is combusted in air, a mixture of two solid compounds are formed. When those two compounds are added to water the basic gas Y is evolved.

i. Identify X.

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ii. Write the electron configuration of the ground state of X .

.....

iii. Write the chemical formulae of the compounds formed in combustion of X in air.

..... and .....

iv. Consider the following compounds of the elements of the other group except the group of X in S block. Inside the given cages, mention whether the given properties below are increasing or decreasing when going down the group.

1. The water solubility of sulphites. ☐
2. The water solubility of hydroxids ☐
3. Thermal stability of metal nitrates. ☐

Give reasons for your answer for (III)

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v. Identify the element of s block which does not belong to the group of x of the periodic table, but reacts with $H_2(g)$, $O_2\ (g)$ and $N_2\ (g)$ in a more similar way to x.

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vi. What is the basic gas y ?

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vi. Give an experiment to identify y?

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vii. What is the observation of the above experiment?

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(b) The test tubes labelled as A to E contain the aqueous solution of Na_2SO_4, Na_2SO_3, $NaOH$, K_2CrO_4 and $Ca(NO_3)_2$ (not in order) The relevant tests carried out for each of these test tubes A to E and the relevant observations are given below.

Test Tube	Test	Observation
A	Add 1 cm^3 of $BaCl_2$ then add dil. HCl.	A white colour precipitate is formed and then it is dissolved.
B	Add $Mg(NO_3)_2$ solution.	A white color precipitate is obtained.
C	Add about 1 cm^3 of $BaCl_2$ solution then add dil. HCl.	A white colour precipitate is formed. it does not dissolve.
D	Add about 1 cm^3 of Na_2CO_3 solution then add dil. HCl.	A white colour precipitate is obtained.
E	Add 1 cm^3 of $BaCl_2$ solution	A yellow colour precipitate is formed.

(i) Identify the solutions present in test tubes A to E.

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

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

E .....

(ii) Write the balanced chemical / ionic equations for the reactions taking place in A, B, C, D and E.

(03) (a) I. To prepare $250\,cm^3$ of $1\,moldm^{-3}$ Na_2CO_3 solution in the laboratory, $Na_2CO_3.5H_2O$ is provided. $(Na = 23\,, C = 12\,, O = 16\,, H = 1)$

i. Calculate the number of moles of Na_2CO_3 required.

ii What is the mass of $Na_2CO_3.5H_2O$ that should be weighed ?

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iii. What is known as a standard solution.

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iv. What is known as a primary standard solution?

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v. Give 2 examples for the primary standards?

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vi. Why is it impossible to prepare a standard $NaOH$ solution with an accurate concentration?

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vii. The concentration of $1\,mol\,dm^{-3}$ Na_2CO_3 solution prepared above can be changed slightly. Give 2 reasons for that.

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viii. What is the glassware which is used to prepare a solution with a known concentration?

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ix. Calculate the volume should be measured from the above $1\ mol\ dm^{-3}\ Na_2CO_3$ solution to prepare $100\ cm^3$ of $0.25\ mol\ dm^{-3}\ Na_2CO_3$ solution.

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(04) In a certain compound, 30.46% of oxygen and 69.54% of nitrogen are present by mass. The relative molecular mass of the compound is within 90-95.

i. Determine the empirical formula of the compound. $(N = 14\ , O = 16)$

ii. Determine the molecular formula of the compound.

iii. Calculate the accurate molar mass of the compound.

(b) I. $KMnO_4$ is a colourful compound.

i. Write the $IUPAC$ name of $KMnO_4$.

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ii. Write the chemical formula of the oxide derived from the oxidation number of Mn in $KMnO_4$.

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iii. Write the election configuration of Mn as $1\,s^2\ 2s^2$ ... ...

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iv. In acidic medium $KMnO_4$ reacts with $K_2C_2O_4$

$(Cr_2O_7^{2-} \rightarrow Cr^{3+})$

$(C_2O_4^{2-} \rightarrow CO_2)$

1. Write the oxidation half reaction.

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2. Write the reduction half reaction.

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3. Write the balanced ionic reaction.

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4. Write the balanced chemical equation if dil. H_2SO_4 is used as the acidic medium.

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(c) At $298\,K$, for the reaction $2NH_3(g) \rightarrow N_2(g) + 3\,H_2(g)$, the standard molar enthalpy is $90\ kJmol^{-1}$. At $298\,K$ the standard entropy change $250\,J\,mol^{-1}K^{-1}$.

i. Calculate ΔG^{θ} for the reaction.

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ii. Explain the spontaneity of the reaction at $298\,K$.

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iii. Calculate the minimum temperature required, for the reaction to be spontaneous.

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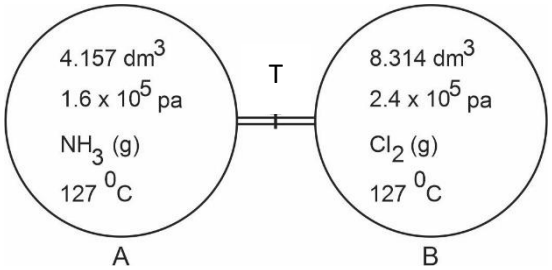
Second Term Test - 200

Chemistry - Grade 12
Part B - Essay

- **Answer two questions only**

(05) (a) Cl_2 gas contains in a closed rigid vessel with the volume of $8.314\ dm^3$ under 2.4×10^5 pa pressure. NH_3 gas contains in another closed rigid vessel with the volume of $4.157\ dm^3$ under 1.6×10^5 pa pressure. Both of these vessels are kept at 127^0C temperature and they are conected each other using a thin glass tube.



(i) Calculate the number of moles of gases exist in each of the vessels separately before open the tap.

(ii) The tap is opened and let both gases to mix each other. Then NH_3 and Cl_2 gases are reacted each other according to the following reaction.

$NH_3(g) + 3Cl_2\ (g)\ \rightarrow\ NCl_3(g) + 3\ HCl\ (g)$

1. Calculate the total number of moles present in the vessels after completing the reaction.
2. Calculate the total pressure of the system after completing the reaction.
3. What happen to the pressure inside the system, when $0.4\ mol$ of $NH_3(g)$ is added to the system without allowing the inner gases to come outside. Explain by giving reasons.
4. Calculate the final pressure in the system.

(b) An experiment is planned by a student to determine the relative molecular mass of Mg experimentally, using molar volume of H_2 in the laboratory.

(i) Draw and label the experimental set up that can be used to this experiment which is carried out using Mg and dil. HCl.

(ii) In this experiment which is carried out by the student the following results are obtained.

Room temperature	$= 27^0C$
Atmospheric pressure	$= 1.013\ x\ 10^5Pa$
Vapour pressure of water	$= 0.036\ x\ 10^5Pa$
the volume H_2 produced	$= 50\ cm^3$
mass of Mg	$= 0.05g$

(i) Write the balanced chemical equation for the reaction between Mg and dil. HCl.

(ii) Calculate the r.a.m. using the above data.

(iii) Mention the assumptions you have used.

(c) (i) Mention the postulates of kinetic molecular theory.
(ii) Write the equation of the kinetic molecular theory and introduce its terms.

(06)(a) Write the balanced chemical equations relevant to the following enthalpy changes.
(i) The standard enthalpy of combustion of $C(s)$ (ΔH_f^θ)
(ii) The standard enthalpy of sublimation of $Na(s)$ (ΔH_s^θ)
(iii) The standard enthalpy of bond dissociation of $O_2\ (g)$ (ΔH_D^θ)
(iv) The standard enthalpy of atomization of Chlorine (ΔH_{atm}^θ)
(v) The standard lattice dissociation enthalpy $MgCl_2(s)$ (ΔH_{LE}^θ)

(b) At 25^0C using the following data for the following reaction, $2H_2(g) + O_2(g) \rightarrow 2\,H_2O\ (g)$
(i) Calculate the standard enthalpy change.
(ii) Calculate the standard entropy change.
(iii) predict that the reactions is spontaneous or non - spontaneous?
The standard bond dissociation enthalpy of H - H $= +432\ kJmol^{-1}$
The standard bond dissociation enthalpy of O = O $= +494\ kJmol^{-1}$
The standard bond dissociation enthalpy of O - H $= +460\ kJmol^{-1}$

Compound	$s^\theta\ /\ J\ k^{-1}mol^{-1}$
$H_2O(g)$	+ 188.8
$H_2\ (g)$	+ 130.7
$O_2\ (g)$	+ 205.1

(c) Calculate the stand lattice enthalpy of by drawing a Born - Haber cycle using the following thermochemical data.
The standard enthalpy of sublimation of $Mg(s)$ $= +148\ kJmol^{-1}$
The standard enthalpy of first ionization of $Mg(g)$ $= +738\ kJmol^{-1}$
The standard enthalpy of second ionization of $Mg(g)$ $= +1451\ kJmol^{-1}$
The standard enthalpy of bond dissociation of $Cl_2\ (g)$ $= +244\ kJmol^{-1}$
The standard enthalpy of formation of $MgCl_2(s)$ $= -641\ kJmol^{-1}$
The standard enthalpy of first electron gaining of $Cl(g)$ $= -349\ kJmol^{-1}$

(07) (a) The data which is obtained in a certain experiment by a student is given below.

$125\ cm^3$ of $2\ mol\ dm^{-3}$ dil. HNO_3 solution and $125\ cm^3$ of $2\ mol\ dm^{-3}\ KOH$ solution are mixed inside a plastic cup. It is observed that the system is reached a maximum temperature of $40^0\ C$. Before mixing all the solutions they are at $27^0\ C$ as the initial temperature. (Specific heat capacity of water $= 4.2\ J\ g^{-1}K^{-1}$ density of water $= 1\ gcm^{-3}$)
(i) Write the balanced chemical equations for the reaction between dil. HNO_3 and KOH .
(ii) Calculate the heat change (Q) for the reaction between HNO_3 and KOH .
(iii) Calculate the standard enthalpy of neutralization for the reaction between HNO_3 and KOH .
(iv) Write two assumptions that is used in this experiment.
(v) What are the reasons to differ the experimentally obtained value here for the standard enthalpy of neutralization, from its standard value.
(vi) How to deviate standard enthalpy value of the reaction between $CH_3COOH\ (aq)$ and $NaOH\ (aq)$ and the standard enthalpy value of the reaction between $Ba(OH)_2(aq)$ and $H_2SO_4(aq)$ from the standard enthalpy of neutralization.

(b) A solution is formed by dissolving the solid residue obtained in the incomplete thermal decomposition of 1.55g of $KNO_3(s)$ and by adding water up to $250\ cm^3$ of total volume. $25\ cm^3$ of this is titrated with $0.015\ moldm^{-3}$ acidified $KMnO_4$ solution. Here the consumed $KMnO_4$ volume is $30\ cm^3$.

$H^+ / MnO_4^- \rightarrow Mn^{2+}$

$NO_2^- \rightarrow NO_3^-$

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

(ii) Calculate the remaining mass of KNO_3 after the thermal decomposition.
$(K = 39\ , Mn = 55\ , O = 16\ , N = 14)$

(C) (i) Write the balanced half ionic reactions relevant to the reduction of $Cr_2O_7^{2-}$ ion to Cr^{3+} in acidic.

(ii) Write he balanced half ionic reaction relevant to the reduction of MnO_4^- ion to MnO_2 in basic medium.

(iii) Write the balanced chemical reaction of I_2 and $Na_2S_2O_3$.

$I_2 \rightarrow I^-$

$S_2O_3^{2-} \rightarrow S_4O_6^{2-}$

Part C - Essay

- **Answer two questions only**

(08) (a) Write the balanced chemical equations relevant to the decomposition of the following compounds.

(i) $Mg(NO_3)_2(s) \xrightarrow[\Delta]{}$ (ii) $NaNO_3(s) \xrightarrow[\Delta]{}$ (iii) $NaHCO_3(s) \xrightarrow[\Delta]{}$

(iv) $LiNO_3(s) \xrightarrow[\Delta]{}$ (v) $CaCO_3\ (s) \xrightarrow[\Delta]{}$

(b) The tests which were carried out with a salt Q and the relevant observations are given below.

Tests	Observation
(i) Na_2SO_4 solution is added to an aqueous solution of *Q*.	A white precipitate is formed and that precipitate is insoluble in dil. HNO_3
(ii) Salt Q is heated.	A brown colour gas is evolved.
(iii) Salt Q is subjected to the flame test.	A yellowish green flame is obtained.

(i) Mention the conclusions of each of the above tests.

(ii) Identify the salt Q.

(iii) Write the balanced chemical equations relevant to the tests (i) and (ii) above.

(c) (i) When $2.48\ g$ of a mixture containing only KNO_3 and $Ca(NO_3)_2$ was subjected to complete thermal decomposition, the mass of the solid residue obtained was $1.98\ g$. Calculate the mass percentages of KNO_3 and $Ca(NO_3)_2$ present in the mixture.
$(Ca = 40\ ,\ K = 39\ ,\ N = 14\ ,\ O = 16)$

(ii) Mention an observation can be seen upon heating this mixture.

(09) (a) Arrange the followings in to the increasing order of the given property. Explain the reasons for your answers.

i. Thermal stability of $Be(NO_3)_2\ ,\ Mg(NO_3)_2\ ,\ Ca(NO_3)_2$

ii. Basicity of $NaOH,\ KOH\ ,\ Mg(OH)_2$

iii. The electro negativity of P in $PF_3\ ,\ PCl_3\ ,\ PI_3$

iv. The boiling point of $H_2O\ ,\ H_2S\ ,\ H_2Se$

(b) Distinguish the following compounds using only the given method in front of them.

i. $Na_2CO_3\ (aq)$, $Na_2SO_4\ (aq)$, $BaCl_2\ (aq)$, $NaNO_3\ (aq)$ — Mixing only two solutions together and using dil. HNO_3 if it is required.

ii. $Na_2CrO_4\ (aq)$, $MgCl_2\ (aq)$, $Ba(NO_3)_2\ (aq)$, $Na_2CO_3\ (aq)$ — By mixing only two solutions together.

iii. $Mg(NO_3)_2\ (aq)$, $NaNO_3\ (aq)$, $Na_2CO_3\ (aq)$ — By heating (the relevant chemical equations for heating should be mentioned)

(c) Write the IUPAC names of the following compounds.

(i) $NaHCO_3$ (ii) $CuSO_4$ (iii) $CuCl$

(iv) $Fe_2(SO_4)_3$ (v) $KMnO_4$

(10) (a) Deduce the shapes of following molecules / ions using $VSEPR$ theory.

(i) XeF_4 (ii) PF_5 (iii) NCl_3

(iv) ClO_4^- (v) NO_3^-

(b) When the inorganic salt X is subjected to complete thermal decomposition, $1.52g$ of Cr_2O_3, $0.72\ g$ of H_2O and $0.28g$ of N_2 are obtained.

i. Deduce the empirical formula of X. $(Cr = 52, N = 14, O = 16, H = 1)$

ii. If X contains 2 moles of Cr and does not contain any H_2O molecule, determine the molecular formula of X.

(c) A solution is prepared by dissolving $200mg$ of a sample of impure $KMnO_4$ in $100\ cm^3$ of H_2O. $15\ cm^3$ of $0.02\ mol\ dm^{-3}$ acidified oxalate $[C_2O_4^-]$ solution is consumed to titrate $25\ cm^3$ of the above solution. Calculate the mass percentage of $KMnO_4$ present in the above $KMnO_4$ sample.

$(K = 39, Mn = 55, O = 16, C = 12)$

$MnO_4^- \rightarrow Mn^{2+}$

$C_2O_4^{2-} \rightarrow CO_2$