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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. ($\begin{array}{ccccccccc} & & H & & O & & H & & \\ & & | & & | & & | & & \\ H & - & N^1 & - & C^2 & - & N & - & H \end{array}$)

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

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

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

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 x 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 x 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, $(KIO_3 = 214)$

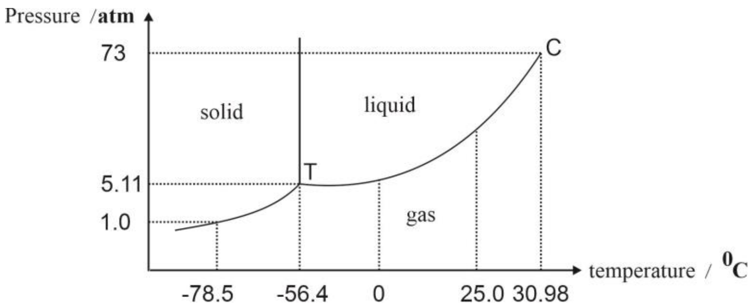
$H^+ / IO_3^- \rightarrow I_2$, $I^- \rightarrow I_2$ and $S_2O_3^{2-} + I_2 \rightarrow S_4O_6^{2-} + I^-$

1. 1.605 x 10^{-2} 2. 1.605   3. 3.21   4. 2.675 x 10^{-3} 5. 2.675 x 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. $\text{Mg(s)} + \frac{1}{2}\ O_2(g) \rightarrow MgO(s)$

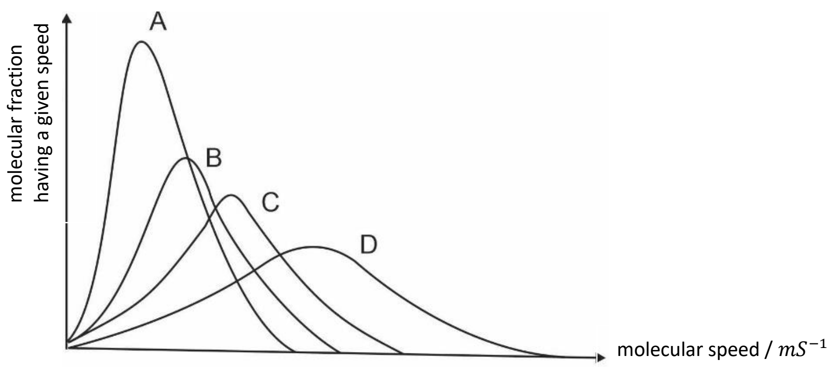
27. Phase diagram of CO_2 is given below.



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.

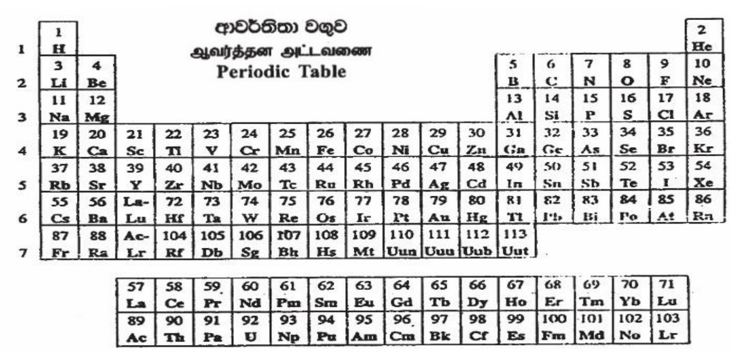
(c) When the number of electrons provided by an atom is increasing then the metallic bond strength is increasing.

(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,* $R = 8.314\ \text{J K}^{-1}\ \text{mol}^{-1}$

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

Plank's constant $h = 6.626 \times 10^{-34}$ J s

Velocity of light $c = 3 \times 10^{8}$ 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.

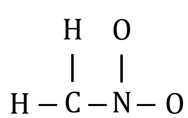
....

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

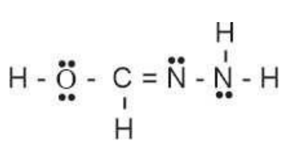
....

(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 ,

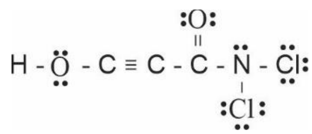
i. $VSEPR$ pairs around atoms.

ii. The electron pair geometry around the atom.

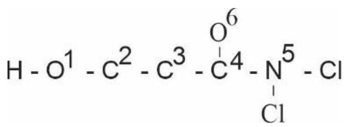
iii. shape around the atom.

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.

....

....

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

....

....

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. $\boxed{}$ $\boxed{}$ -1 $4P$

2. 4 2 0 $\boxed{}$

3. $\boxed{}$ $\boxed{}$ $\boxed{}$ $3s$

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.

....

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. $\boxed{\quad}$
2. The water solubility of hydroxids $\boxed{\quad}$
3. Thermal stability of metal nitrates. $\boxed{\quad}$

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.

....

vi. What is the basic gas y ?

....

vi. Give an experiment to identify y?

....

vii. What is the observation of the above experiment?

....

....

(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 ?

iii. What is known as a standard solution.

iv. What is known as a primary standard solution?

v. Give 2 examples for the primary standards?

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

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

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

....

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. $\mathrm{KMnO_4}$ is a colourful compound.

i. Write the $IUPAC$ name of $\mathrm{KMnO_4}$.

....

....

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

....

....

....

....

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

....

....

iv. In acidic medium $\mathrm{KMnO_4}$ 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.

....

....

2. Write the reduction half reaction.

....

....

3. Write the balanced ionic reaction.

....

....

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

....

....

(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.

....

....

....

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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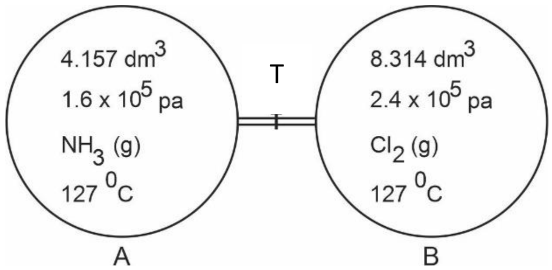
Second Term Test - 200

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	=	$1.013\ x\ 10^5 Pa$
Vapour pressure of water	=	$0.036\ x\ 10^5 Pa$
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) $Mg(NO_3)_2(s) \underset{\Delta}{\rightarrow}$ (ii) $NaNO_3(s) \underset{\Delta}{\rightarrow}$ (iii) $NaHCO_3(s) \underset{\Delta}{\rightarrow}$

(iv) $LiNO_3(s) \underset{\Delta}{\rightarrow}$ (v) $CaCO_3\ (s) \underset{\Delta}{\rightarrow}$

(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. $\left.\begin{array}{c} Na_2CO_3\ (aq) \\ Na_2SO_4\ (aq) \\ BaCl_2\ (aq) \\ NaNO_3\ (aq) \end{array}\right\}$ Mixing only two solutions together and using dil. HNO_3 if it is required.

ii. $\left.\begin{array}{c} Na_2CrO_4\ (aq) \\ MgCl_2\ (aq) \\ Ba(NO_3)_2\ (aq) \\ Na_2CO_3\ (aq) \end{array}\right\}$ By mixing only two solutions together.

iii. $\left.\begin{array}{c} Mg(NO_3)_2\ (aq) \\ NaNO_3\ (aq) \\ Na_2CO_3\ (aq) \end{array}\right\}$ 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.

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

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

$C_2O_4^{2-} \rightarrow CO_2$

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ஆவர்த்தன அட்டவணை

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

Second Team Test - Grade 12 - 2020
Chemistry Answer Script - Part A

Part I

(1) – 4	(11) – 3	(21) – 2	(31) – 2	(41) – 1
(2) – 1	(12) – 4	(22) – 4	(32) – 4	(42) – 4
(3) – 2	(13) – 1	(23) – 2	(33) – 3	(43) – 5
(4) – 5	(14) – 3	(24) – 4	(34) – 5	(44) – 5
(5) – 3	(15) – 1	(25) – 5	(35) – 5	(45) – 2
(6) – 1	(16) – 5	(26) – 3	(36) – 1	(46) – 4
(7) – 4	(17) – 3	(27) – 1	(37) – 4	(47) – 1
(8) – 2	(18) – 4	(28) – 2	(38) – 2	(48) – 3
(9) – 5	(19) – 5	(29) – 3	(39) – 1	(49) – 2
(10) – 3	(20) – 4	(30) – 1	(40) – 2	(50) – 3

Chemistry Answer Script - Part B

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.)

Na

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

Al

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

Mg

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

Cl

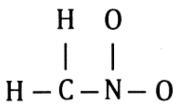
v. Identify the element which forms electron deficient compounds and existing as dimers in gaseous state.

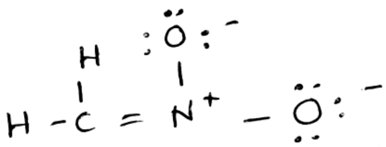
Al

(5 x 04 marks = 20)

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

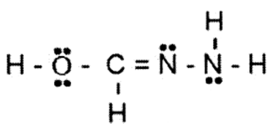
I.

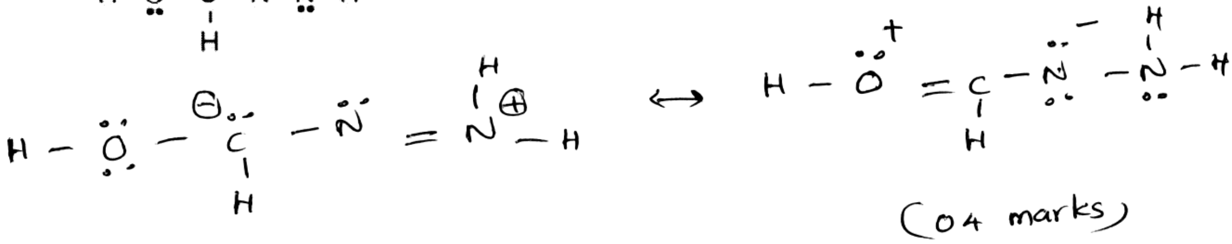




(06 marks)

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 yourself.





(04 marks)

(04 marks)

unstable (02 marks)

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

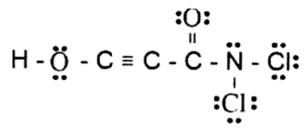
i. $VSEPR$ pairs around atoms.

ii. The electron pair geometry around the atom.

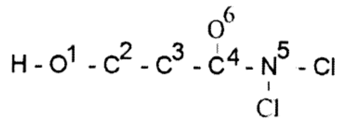
iii. shape around the atom.

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	4	2	2	4
Electron pair geometry	tetrahedral	linear	linear	tetrahedral
shape	angular	linear	linear	trigonal pyramidal
Hybridization	sp^3	sp	sp	sp^3
Oxidation Number	-2	+1	0	+1

(20x 01 mark = 20)

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 1s a.o. O^1 sp^3 h.o.

II. $O^1 - C^2$ O^1 sp^3 h.o. C^2 sp h.o.

III. $C^2 - C^3$ C^2 sp h.o C^3 sp h.o.

IV. $C^3 - C^4$ C^3 sp h.o. C^4 sp^2 h.o.

Vi. $C^4 - N^5$ C^4 sp^2 h.o. N^5 sp^3 h.o.

Vi. $C^4 - O$ C^4 sp^2 h.o. O 2p a.o. or sp^2 h.o.

(12x01 mark = 12)

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 ......2p a.o . C^3 ......2p a.o.

II. $C^4 - O^6$ C^4 ......2p a.o. O^6 ......2p a.o.

(4 x 01 mark = 4)

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.

perpendicularty to each other. (02 marks)

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

HCN or any correct answer (02 marks)

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. $\boxed{4}$ $\boxed{1}$ -1 $4P$

2. 4 2 0 $\boxed{4d}$

3. $\boxed{3}$ $\boxed{0}$ $\boxed{0}$ $3s$

(6 x 01 mark = 6)

ii. A ~~a~~rrange the following in to the increasing order of the property mentioned inside the parenthesis is,

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

$BeCO_3$ < $MgCO_3$ < $CaCO_3$

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

NO_2^- < NO_2 < NO_2^+

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

C_2H_2 < C_2H_4 < C_2H_6 (3 x 06 marks = 18)

(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~~d~~ 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.

Li (07 marks)

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

$1s^2\ 2s^1$ (04 marks)

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

Li_2O (03 marks) and Li_3N (03 marks)

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. $\boxed{\text{decreasing}}$ (03 marks)
2. The water solubility of hydroxids $\boxed{\text{Increasing}}$ (03 marks)
3. Thermal stability of metal nitrates. $\boxed{\text{Increasing}}$ (03 marks)

Give reasons for your answer for (III)

When going down the group, cationic radius is increasing (03 marks)

polarizing power is decreasing (02 marks)

covalent character is decreasing then the thermal stability increasing. (03 marks)

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.

Mg (04 marks.)

vi. What is the basic gas y ?

NH_3 (04 marks)

vi. Give an experiment to identify y?

passing the gas through moistened litmus or any correct answer (04 marks)

vii. What is the observation of the above experiment?

Red litmus turned blue. (04 marks)

or to a correct observation.

To award marks for (i) to (v), (i) should be correct.

To award marks for (vi) to (viii), (vi) should be correct.

(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 ....Na_2SO_3.... B ....$NaOH$....

C ....Na_2SO_4.... D ....$Ca(NO_3)_2$....

E ....K_2CrO_4....

(5 x 05 marks = 25)

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

$Na_2SO_3 + BaCl_2 \longrightarrow BaSO_3 + 2NaCl$

$2NaOH + Mg(NO_3)_2 \longrightarrow Mg(OH)_2 + 2NaNO_3$.

$Na_2SO_4 + BaCl_2 \longrightarrow BaSO_4 + 2NaCl$

$Ca(NO_3)_2 + Na_2CO_3 \longrightarrow CaCO_3 + 2NaNO_3$

$BaCl_2 + K_2CrO_4 \longrightarrow BaCrO_4 + 2KCl$

(5 x 05 marks) = 25)

(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.

$n = C \cdot V$ ✓

$= 1\ moldm^{-3} \times 250 \times 10^{-3}\ dm^3$ ✓✓

$= 0.25\ mol$ ✓✓

(5 x 2 marks = 10)

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

M ($Na_2CO_3 . 5H_2O$) = (23 × 2) + 12 + (16 × 3) + (5 × 16) = 196

m = n . M = 0.25 mol × 196 g mol^{-1}

m = 49 g

02 marks × 7 = 14

for the unit of the final answer = 1 (15 marks.)

iii. What is known as a standard solution.

A solution with a known concentration

(05 marks)

iv. What is known as a primary standard solution?

For the preparation of a standard solution, if extremely pure, stable, highly water soluble substance with a high molecular mass should be used. Also that substance should not be hydrated. That types of a solution is known as a primary standard solution

(15 marks)

v. Give 2 examples for the primary standards?

Na_2CO_3, $K_2Cr_2O_7$, KIO_3

For any 2, (2 × 05 marks = 10)

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

The concentration can be changed due to the dissolution of CO_2.

(10 marks)

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

- $Na_2CO_3 . 5H_2O$ is not very pure.
- The number of water molecules bonded can be changed.

(2 × 05 marks = 10)

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

Volumetric flask (10 marks)

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.

$C_1V_1 = C_2V_2$ (5 marks)

$1\ mol dm^{-3} \times V = 0.25\ mol dm^{-3} \times 100\ cm^3$ (04+1) marks

$V = 25\ cm^3$ (04+1) marks.

* If calculated using the statements award the marks

(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. ($N = 14, O = 16$)

	N	O
	30.46%	69.54%
mass	30.46	69.54
$n = \frac{m}{M}$	$30.46 / 14 g mol^{-1}$	$69.54 / 16 g mol^{-1}$
	2.17 mol	4.34 mol
ratio	1	2

Empirical Formula $= NO_2$

ii. Determine the molecular formula of the compound.

(mass of the empirical formulula)n = r.a.m

$[14 + (16 \times 2)]n = 90-95$

$46n \approx 90-95$

$n \approx \frac{90-95}{46} = 2$

$\therefore$ molecular formula $= NO_2 \times 2 = N_2O_4$

iii. Calculate the accurate molar mass of the compound.

$N_2O_4 = [(14 \times 2) + (16 \times 4)]\ g mol^{-1}$

$= 92\ g mol^{-1}$

(02 marks x 10 = 20)

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

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

potassium permanganate (05 marks)

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

Mn_2O_7 (05 marks)

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

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^2$ (05 marks)

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.

$\underset{+3}{C_2O_4^{2-}} \rightarrow \underset{+4}{2CO_2} + 2e$ (10 marks)

2. Write the reduction half reaction.

$14H^+ + \underset{+6}{Cr_2O_7^{2-}} + 6e \rightarrow \underset{+3}{2Cr^{3+}} + 7H_2O$ (10 marks)

3. Write the balanced ionic reaction.

$14H^+ + Cr_2O_7^{2-} + 3C_2O_4^{2-} \rightarrow 6CO_2 + 2Cr^{3+} + 7H_2O$ (05 marks)

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

$7H_2SO_4 + K_2Cr_2O_7 + 3K_2C_2O_4 \rightarrow 6CO_2 + Cr_2(SO_4)_3 + 4K_2SO_4 + 7H_2O$ (05 marks)

For the reaction,

(c) At 298 K, $2NH_3(g) \rightarrow N_2(g) + 3\,H_2(g)$, 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.

$\Delta G^{\theta} = \Delta H^{\theta} - T\Delta S^{\theta}$ (05 marks)

$= (90\,kJ\ mol^{-1} - 298\,K \times 250 \times 10^{-3}\,kJ\,mol^{-1}K^{-1})$ (04 marks +1)

$= 15.5\ kJmol^{-1}$ (04 marks +1)

ii. Explain the spontaneity of the reaction at 298 K.

$\Delta G^{\theta} = (+)$ve.

$\therefore$ The reaction is not spontaneous.

(05 marks)

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

To be spontaneous $\Delta G < 0$ (03 marks)

$\Delta H - T\Delta S < 0$ (03 marks)

$\Delta H < T\Delta S$

$\frac{\Delta H}{\Delta S} < T$ (03 marks)

$\frac{90\ kJ\ mol^{-1}}{0.25\,kJ\,mol^{-1}K^{-1}} < T$ (02+1) marks

$\underline{\underline{360\ K}} < T$ (03 marks)

Chemistry - 2020
Grade - 12 - 2nd term test
Answers - Essay

5 (a). (i). Applying, $PV = nRT$ to the vessel A,

$1.6 \times 10^5\ Nm^{-2} \times 4.157 \times 10^{-3}\ m^3 = n_A \times 8.314\ J mol^{-1} K^{-1} \times 400 K$

moles of NH_3 $(n_A) = 0.2\ mol$

To the vessel B,

$2.4 \times 10^5\ Nm^{-2} \times 8.314 \times 10^{-3}\ m^3 = n_B \times 8.314\ J mol^{-1} K^{-1} \times 400 K$

moles of Cl_2 $(n_B) = 0.6\ mol.$

(5 x 3 marks = 15)

(ii). I. $NH_3(g) + 3Cl_2(g) \rightarrow NCl_3(l) + 3HCl(g)$.

Initial moles	0.2	0.6	-	-
Final moles	-	-	0.2	0.6

Total number of gaseous moles in the vessels $\}$ = 0.6 mol

(3 x 5 marks = 15).

II. Apply $PV = nRT$ To the final system,

$P \times 12.471 \times 10^{-3}\ m^3 = 0.6\ mol \times 8.314\ J mol^{-1} K^{-1} \times 400 K$

$P = 1.6 \times 10^5\ Pa$.

(20 marks)

III. All $Cl_2(g)$ and $NH_3(g)$ were reacted completely inside the system, when $NH_3(g)$ is added since unreacted $Cl_2(g)$ is not existing, a reaction doesnot take place. But because of the addition of 0.4 mol of $NH_3(g)$, its partial pressure adds to the total pressure. ∴ The total pressure is increasing

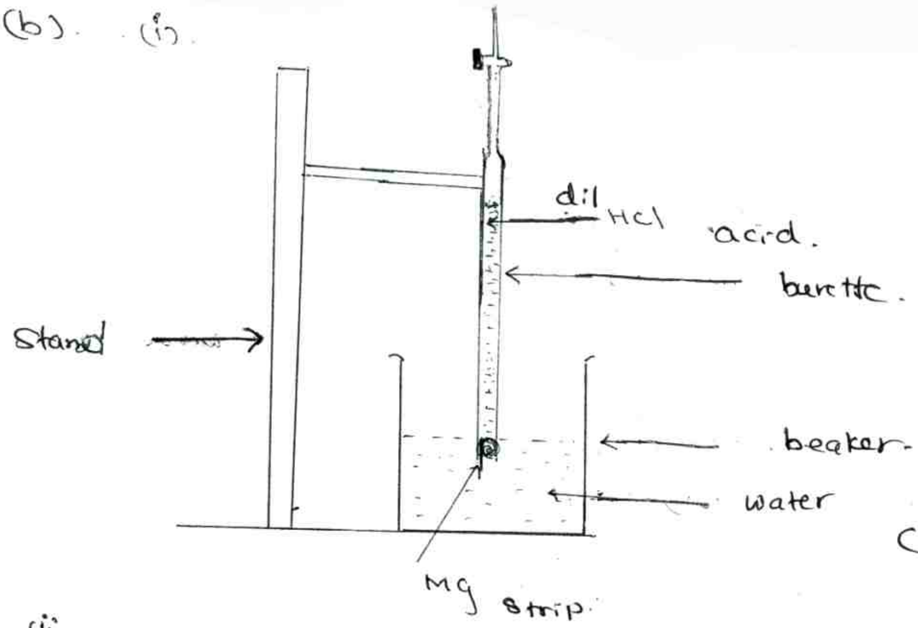
(10 marks)

IV. $PV = nRT$ to the system,

$P \times 12.471 \times 10^{-3}\ m^3 = 1 mol \times 8.314\ J mol^{-1} K^{-1} \times 400 K$

(marks : 8)

$P = 2.66 \times 10^5\ Nm^{-2}$. (7 marks) (b). (i)



(20 marks)

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

(5 marks)

(iii) $P_{H_2} = P_T - P_{H_2O}$

$= 1.013 \times 10^5 pa - 0.036 \times 10^5 pa$

$= \underline{\underline{0.977 \times 10^5 pa}}$

To $H_{2}(g)$, $PV = nRT$

$0.977 \times 10^5 pa \times 50 \times 10^{-6} m^3 = n \times 8.314\ J mol^{-1} K^{-1} \times 300$

$n = 0.002 mol$ (0.0019)

molar ratio, Mg : H_2

is 1 : 1 so,

moles of Mg = 0.002 mol

mass of Mg $= \dfrac{Mg_{mass}}{Mg_{r.a.m.}}$

$0.002 mol = \dfrac{0.05g}{Mg_{r.a.m.}}$

$\therefore$ r.a.m of Mg $= \underline{\underline{25}}$

(5×5 marks = 25)

(iv)

Assumption - H_2 gas behaves ideally. (5 marks)

$\boxed{\text{marks-55}}$

(C) (i) Assumptions :-

* The true volume of the particles are very smalle relative to the empty spaces existing among them.
* All gas molecules travel in straight lines until they collide with each other or collide with the wall of the vessel.
* The collisions of the gas molecules occurred with each other ~~of the gas molecules~~ or the collisions occurred with the walls of the container is perfectly elastic.
* The attractive forces or repulsive forces donot exist among the gas particles
* A pressure is exeerted by the gas because of the all collisions occurred by the gas molecules with the walls of the container. (marks 2 x 5 = 10)

(ii) $PV = \frac{1}{3} mN\overline{c^2}$ (05 marks)

P = Pressure.
V = volume of the gas.
m = mass of a ~~partike~~/molecule of the gas.
N = the total number of gas particles / molecules.
$\overline{c^2}$ = Mean square speed

(05 marks)

$\boxed{\text{20 marks}}$

6 (a).

(i). $C(s) + O_2(g) \rightarrow CO_2(g)$; ΔH_f^Θ

(ii). $Na(s) \rightarrow Na(g)$; ΔH_S^Θ

(iii). $O_2(g) \rightarrow 2O(g)$; ΔH_D^Θ

(iv). $\frac{1}{2}Cl_2(g) \rightarrow Cl(g)$; ΔH_{atm}^Θ

(v). $Mg^{2+}(g) + 2Cl^-(g) \rightarrow MgCl_2(s)$; ΔH_{LE}^Θ

(5x5 marks = 25).

$\boxed{\text{marks - 25}}$

(b). (i).

$$\begin{array}{ccc} 2H_2(g) + O_2(g) & \xrightarrow{\Delta H_f^\Theta} & 2H_2O(g) \\ \big\downarrow {\scriptstyle 2\times 432\ kJmol^{-1} + 494\ kJmol^{-1}} & & \big\downarrow {\scriptstyle 4\times 460\ kJmol^{-1}} \\ & 4H(g) + 2O(g) & \end{array}$$

substitution of values - 2x3 = 06
balanced equations 2x2 = 04

By applying Hess's law,

$$\Delta H_f^\Theta + 4\times 460\ kJmol^{-1} = 2\times 432\ kJmol^{-1} + 494\ kJmol^{-1}$$

$$\Delta H_f^\Theta + 1840 = 864 + 494$$

$$\Delta H_f^\Theta = 1358 - 1840$$

$$\underline{\underline{\Delta H_f^\Theta = -482\ kJmol^{-1}}}$$

OR

(2x5 marks = 10)

$$\Delta H_f^\Theta = \Sigma \Delta H^\Theta_{D\,(\text{ප්‍රතික්‍රියක})} - \Sigma \Delta H^\Theta_{D\,(\text{ප්‍රතිඵල})}$$

$$= 2\times 432\ kJmol^{-1} + 494\ kJmol^{-1} - 4\times 460\ kJmol^{-1}$$

$$= 864 + 494 - 1840$$

(ii) $\Delta S^{\ominus}_r = S^{\ominus}_{(Products)} - S^{\ominus}_{(Reactants)}$

$= 2\times 188.8\ J\,K^{-1}mol^{-1} - \{2\times 130.7\ J\,K^{-1}mol^{-1} + 205.1\ J\,K^{-1}mol^{-1}\}$

$= 377.6 - \{261.4 + 205.1\}$

$= 377.6 - 466.5$

$= -88.9\ J\,K^{-1}mol^{-1}$ (5×4 marks = 20)

(iii) $\Delta G^{\ominus}_r = \Delta H^{\ominus}_r - T\Delta S^{\ominus}_r$

$= -482\ kJ\,mol^{-1} - 298\ K \times (-88.9\ J\,mol^{-1}K^{-1})$

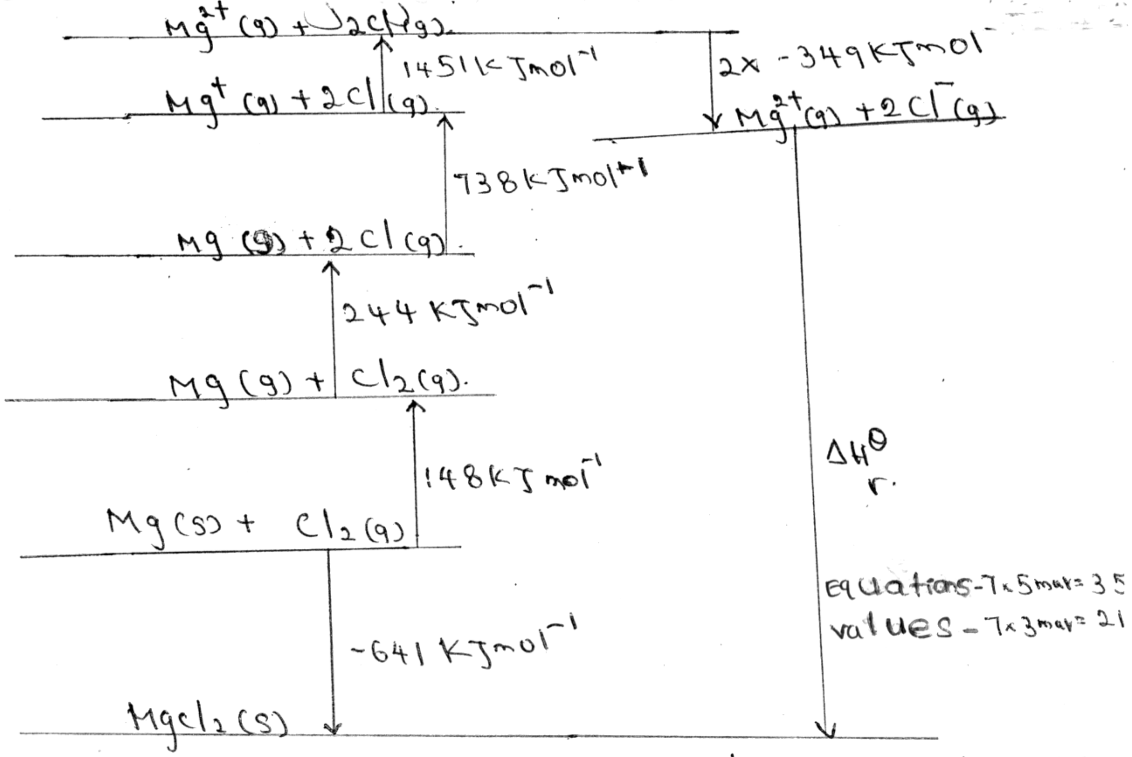
$= -482\ kJ\,mol^{-1} + 26492.2\ J\,mol^{-1}$

$= (-482 + 26.49)\ kJ\,mol^{-1}$

$= -455.51\ kJ\,mol^{-1}$ (5×2 marks = 10)

Since $\Delta G^{\ominus}_r < 0$,
Reaction is spontaneous. (05 marks) $\boxed{55\ marks}$

(c).



$\Delta H^{\ominus}_r + 2\times(-349\ kJ\,mol^{-1}) + 1451\ kJ\,mol^{-1} + 738\ kJ\,mol^{-1} + 244\ kJ\,mol^{-1}$
$+ 148\ kJ\,mol^{-1} = -641\ kJ\,mol^{-1}$

$\Delta H^{\ominus}_r = -2224\ kJ\,mol^{-1}$ (2×7 marks = 14)

$\boxed{70\ marks}$

(4)

(7) (a)

(i) $HNO_3 + KOH \rightarrow KNO_3 + H_2O$. (5 marks)

(ii) $Q = mc\Delta T$ (4 marks)

$= 250\,cm^3 \times 1g\,cm^{-3} \times 4.2\,J\,K^{-1}g^{-1} \times (313 - 300)K$

$= 13650\,J$

$= \underline{13.65\,kJ}$

(5 x 2 marks = 10)

(iii) HNO$_3$ moles added $= \frac{2 \times 125}{1000}$

$= 0.25\,mol$

Heat liberated by 0.25 mol of HNO$_3$ $= 13.65\,kJ$

Heat liberated by 1 mol of HNO$_3$ $= \frac{13.65\,kJ}{0.25\,mol}$

$= 54.6\,kJ\,mol^{-1}$

∴ The standard enthalpy of neutralisation $= \underline{-54.6\,kJ\,mol^{-1}}$

(3x5 marks = 15)

(iv) I. The total heat released by the reaction is absorbed ~~by~~ the completely by the solution. (no heat loss to the surroundings and the plastic vessel is heat insulated.)

II. The consideration of the density of the final solution is equal to that density of water and s.h.c of the solution is equal to the s.h.c. of ~~the~~ water.

(marks 5 x 2 = 10)

(v). The reasons to deviate from the standard value are the heat loss to the surrounding and a part of the heat evolved by the reaction exchanges to the plastic vessel.

(5 marks)

(vi) $CH_3COOH\,(aq) + NaOH\,(aq) \rightarrow CH_3COONa\,(aq) + H_2O\,(l)$

Since acetic acid is a weak acid ~~the~~ a part of the heat evolved is gained to its dissociation. Then the standard enthalpy of neutralisation takes a lower value than $-57\,kJ\,mol^{-1}$

$H_2SO_4\,(aq) + Ba(OH)_2\,(aq) \rightarrow BaSO_4\,(s) + 2H_2O\,(l)$

Here the standard enthalpy takes a value greater than $-114\,kJ\,mol^{-1}$ because of the formation of 2 moles of $H_2O\,(l)$ and the precipitation of $BaSO_4\,(s)$

65 marks

(b) (i) $2KNO_3(s) \xrightarrow{\Delta} 2KNO_2(s) + O_2(g)$ ✓

$5NO_2^- + 6H^+ + 2MnO_4^- \rightarrow 5NO_3^- + 2Mn^{2+} + 3H_2O$ ✓

(2 x 10 marks = 20)

(ii) moles of $KMnO_4$ required $= \frac{0.015 \times 30}{1000}$ ✓

$= 4.5 \times 10^{-4}$ mol ✓

∴ number of moles of NO_2^- present in $25 cm^3$ of the solution $= \frac{4.5 \times 10^{-4} mol \times 5}{2}$ ✓

$= 11.25 \times 10^{-4}$ mol

number of moles of NO_2^- present in $250 cm^3$ of the solution $= \frac{11.25 \times 10^{-4} mol \times 250}{25}$ ✓

$= 11.25 \times 10^{-3}$ mol ✓

∴ moles of KNO_2 $= 11.25 \times 10^{-3}$ mol ✓

The number of moles of KNO_3 decomposed $= 11.25 \times 10^{-3}$ mol ✓

∴ the mass of KNO_3 decomposed $= 11.25 \times 10^{-3} mol \times 101 g mol^{-1}$ ✓

$= 1.13$ g ✓

Remaining mass of KNO_3 $= 1.55 g - 1.13 g$

$= \underline{0.42 g}$ ✓

(10 x 3 marks = 30)

$\boxed{50 \text{ marks}}$

(c) (i) $6e + Cr_2O_7^{2-} + 14H^+ \longrightarrow 2Cr^{3+} + 7H_2O$

(10 marks)

(ii) $2H_2O + MnO_4^- + 3e \longrightarrow MnO_2 + 4\bar{O}H$

(10 marks)

(iii) $I_2 + 2Na_2S_2O_3 \longrightarrow 2NaI + Na_2S_4O_6$

(15 marks)

$\boxed{35 \text{ marks}}$

8) (a)

(i) $2Mg(NO_3)_{2(s)} \xrightarrow{\Delta} 2MgO_{(s)} + 4NO_{2(g)} + O_{2(g)}$

(ii) $2NaNO_{3(s)} \xrightarrow{\Delta} 2NaNO_{2(s)} + O_{2(g)}$

(iii) $2NaHCO_{3(s)} \xrightarrow{\Delta} Na_2CO_{3(s)} + H_2O_{(g)} + CO_{2(g)}$

(iv) $4LiNO_{3(s)} \xrightarrow{\Delta} 2Li_2O_{(s)} + 4NO_{2(g)} + O_{2(g)}$

(v) $CaCO_{3(s)} \xrightarrow{\Delta} CaO_{(s)} + CO_{2(g)}$

(5 x 10 marks = 50)

$\boxed{\text{50 marks}}$

(b) I. (i) It contains Ba^{2+} ✓ or Sr^{2+} ✓

(ii) The gas is NO_2 ✓

The salt should be $Ba(NO_3)_2$ ✓ or $Sr(NO_3)_2$ ✓

(iii) ✓ Ba^{2+} ion gives a yellowish green to the flame

(6 x 5 marks = 30)

II. Salt - $Ba(NO_3)_2$ (10 marks)

III. i. $Ba(NO_3)_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaNO_3$ ✓

ii. $2Ba(NO_3)_{2(s)} \xrightarrow{\Delta} 2BaO + 4NO_2 + O_2$ ✓

(2x 10 marks = 20)

$\boxed{\text{60 marks}}$

(c) (i) $2KNO_{3(s)} \xrightarrow{\Delta} 2KNO_{2(s)} + O_{2(g)}$ ✓

x mol — x mol

$2Ca(NO_3)_{2(s)} \xrightarrow{\Delta} 2CaO_{(s)} + 4NO_2 + O_2$ ✓

y mol — y mol

(2 x 3 marks = 6)

moles of KNO_3 = x mol
moles of $Ca(NO_3)_2$ = y mol

$101x + 164y = 2.84$ — ① ✓
$85x + 56 = 1.98$ — ② ✓

(2x 4 marks = 8)

① × 85 − ② × 101,
$8284y = 41.42$
$y = 0.005$ mol ✓

∴ mass of $Ca(NO_3)_2$ = $0.005\ mol \times 164\ g\ mol^{-1}$ ✓
= 0.82g ✓

mass percentage of $Ca(NO_3)_2$ = $\frac{0.82g}{2.84g} \times 100\%$ ✓
= 28.87 % ✓

∴ mass percentage of KNO_3 = 100 − 28.87
= 71.13 % ✓

(6x 3marks = 18)

(ii) The evolution of a brown colour gas

(8 marks)

$\boxed{\text{40 marks}}$

09 (a) (i) $Be(NO_3)_2$ $Mg(NO_3)_2$ $Ca(NO_3)_2$
Be^{2+} NO_3^- Mg^{2+} NO_3^- Ca^{2+} NO_3^-

Here the anion is common (NO_3^-) ✓
radius of cations varies as, $Be^{2+} < Mg^{2+} < Ca^{2+}$ ✓
∴ polarizing power, $Be^{2+} > Mg^{2+} > Ca^{2+}$ ✓

covalent character, $BeCO_3 > MgCO_3 > CaCO_3$
ionic character, $BeCO_3 < MgCO_3 < CaCO_3$ } ✓

∴ The thermal stability, $BeCO_3 < MgCO_3 < CaCO_3$ ✓
(5x2marks = 10)

(ii) NaOH KOH $Mg(OH)_2$

Here OH^- anion is common ✓

cationic radius $Mg^{2+} < Na^+ < K^+$ ✓

∵ Polarizing power $Mg^{2+} > Na^+ > K^+$ ✓

∴ the covalent character, $Mg(OH)_2 > NaOH > KOH$

ionic character, $Mg(OH)_2 < NaOH < KOH$ ✓

∴ the basicity, $Mg(OH)_2 < NaOH < KOH$ ✓

* The correct answer can be obtained based on the ~~the~~ electronegativity values

(5 × 2 marks = 10)

(iii)

	PF_3	PCl_3	PI_3	
hybridization	sp^3	sp^3	sp^3	✓
charge	0	0	0	✓
Oxidation number	+3	+3	+3	✓

Therefore to compare the electronegativities of P, the electronegativity of the other atoms bonded to P should be considered. ✓

The electronegativity varies as, F > Cl > Br ✓

So $\delta+$ of P is increasing as, $PF_3 > PCl_3 > PI_3$

∴ the electronegativity, $PF_3 > PCl_3 > PI_3$ ✓

(7 × 2 marks = 14)

(iv) Hydrogen bonds are present in H_2O. ✓ Dipole - Dipole attractions are present among the molecules of H_2S and H_2Se. ✓

But since the molar mass of H_2Se is greater than that of H_2S, dipole - dipole interactions of H_2Se is greater than that of H_2S ✓ since Hydrogen bonds present in H_2O is stronger than the dipole - dipole

8

attractions present in H_2S and H_2Se, it is difficult to vapourize.

∴ boiling points vary as $H_2O > H_2Se > H_2S$

(6 x 2.5 marks = 15)

total marks 49

(b).(i)

	$Na_2CO_{3(aq)}$	$Na_2SO_{4(aq)}$	$BaCl_{2(aq)}$	$NaNO_{3(s)}$
$Na_2CO_{3(s)}$	-	-	$BeCO_3(s)$ white	-
$Na_2SO_{4(aq)}$	-	-	$BaSO_4(s)$ white	-
$BaCl_{2(aq)}$	$BeCO_3(s)$ white	$BaSO_4(s)$ White	-	-
$NaNO_{3(aq)}$	-	-	-	-

(10 marks)

In mixing solution pairs as above, when $BaCl_{2(aq)}$ is added, two white colour precipatates are obtained. When dil HNO_3 is added, if the white precipitats formed, are insoluble it should be $BaSO_4(s)$, the presence of Na_2SO_4 can be concluded.

If the white precipitate dissolves in dil HNO_3, it can be concluded that $BaCO_3(s)$ is present and the solution contains $Na_2SO_4(aq)$. When solution pairs are mixing as above, $NaNO_3$ does not give any precipitate.

(7 x 2 marks = 14)

(c) (i) $NaHCO_3$ -- sodium hydrogen Corbonate

(ii) $CuSO_4$ - copper(II) sulfate

(iii) $CuCl$ - Co(I) Chloride

(iv) $Fe_2(SO_4)_3$ - Iron(III) sulfate

(v) $KMnO_4$ - potassium permonganate

(5 x 5 marks = 25)

(b) ii

	Na_2CrO_4 (aq)	$MgCl_2$ (aq)	$Ba(NO_3)_2$ (aq)	Na_2CO_3 (aq)	
Na_2CrO_4 (aq)	—	—	$BaCrO_4$ (s) yellow	—	✓
$MgCl_2$ (aq)	—	—	—	$MgCO_3$ (s) white	✓
$Ba(NO_3)_2$ (aq)	$BaCrO_4$ (s) Yellow	—	—	$BaCO_3$ (s) White	✓
Na_2CO_3 (aq)	—	$MgCO_3$ (s) white	$BaCO_3$ (s) white	—	✓

(4 x 2.5 marks = 10)

In mixing solution pairs as above, if only a yellow colour precipitate ✓ is formed, the added solution should be Na_2CrO_4 (aq). ✓ If only a white colour ✓ precipitate is is obtained it is $MgCl_2$ (aq). ✓ If two white precipitates ✓ are formed, the added solution should be Na_2CO_3 (aq). ✓ upon the addition of $Ba(NO_3)_2$ (aq) ✓ a white colour precipitate and a yellow colour precipitate is are formed ✓

(9 x 2marks = 18)

(iii) $2Mg(NO_3)_2\,(aq) \xrightarrow{\Delta} 2MgO\,(s) + 4NO_2\,(g) + O_2\,(g)$ ✓

$2NaNO_3\,(aq) \xrightarrow{\Delta} 2NaNO_2\,(s) + O_2\,(g)$ ✓

$Na_2CO_3\,(aq) \xrightarrow{\Delta} \times$ ✓

In heating, Na_2CO_3 does not ~~si~~ occur any change. ✓ If a brown colour gas is evolved upon heating that is $Mg(NO_3)_2$. ✓ When it is heating, a solid residue and a colourless gas is given by $NaNO_3$ (aq) ✓

(6 x 4 marks = 24)

$\boxed{\text{total marks} = 76}$

(C) (i) $NaHCO_3$ - sodium hydrogen carbonate ✓

(ii). $CuSO_4$ - copper (II) sulfate ✓

(iii). $CuCl$ - copper (I) Chloride ✓

(iv). $Fe_2(SO_4)_3$ - Iron (III) sulfate ✓

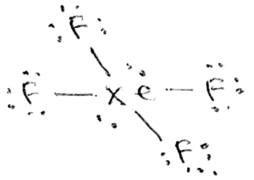
(v). $KMnO_4$ - Potassium permanganate ✓

(5 x 5 marks = 25)

9

(10) (a).

(i) XeF_4



Total number of electron pairs around the central atom $\} = 6$ ✓

VSEPR pairs $= 6$ ✓

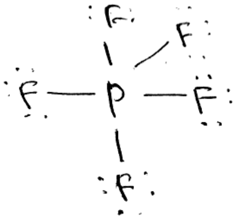
σ bonds $= 4$

lone pairs $= 2$ ✓ (3×2 marks = 6)

∴ the shape is square planer ✓

(4 marks)

(ii). PF_5



total e pairs around P $= 5$

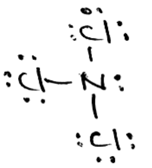
VSEPR Pairs $= 5$

σ bonds $= 5$

lone pairs $= 0$

∴ the shape is trigonal bipyramidal

(iii). NCl_3



The total number of e pairs around N $\} = 4$

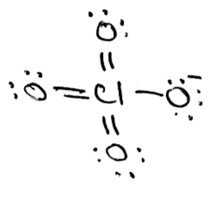
VSEPR pairs $= 4$

σ bonds $= 4$

lone pairs $= 0$

∴ The shape is trigonal pyramidal

(iv). ClO_4^-



The number of total e pairs around Cl $\} = 7$

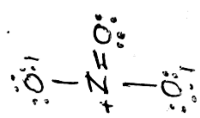
VSEPR pairs $= 4$

σ bonds $= 4$

lone pairs $= 0$

∴ The shape is tetrahedral

(v).



The total number of e pairs around N $\} = 4$

VSEPR pairs $= 3$

σ bonds $= 3$

lone pairs $= 0$

(5×10 marks)

$\boxed{\text{Total marks} = 50}$

(b). moles of Cr_2O_3 $= \frac{1.52g}{152gmol^{-1}}$

$= 0.01mol$

moles of H_2O $= \frac{0.72g}{18gmol^{-1}}$

$= 0.04mol$

moles of N_2 $= \frac{0.28g}{28gmol^{-1}}$

$= 0.01 mol$

molar ratio of,

$Cr_2O_3 : H_2O : N_2$

$0.01 : 0.04 : 0.01$

$1 : 4 : 1$

∴ atomic molar ratio, Cr : H : N : O

2 : 8 : 2 : 7

∴ Empirical formula $Cr_2H_8N_2O_7$

(5x 4 marks = 20)

molecular formula of X, $Cr_2H_8N_2O_7$

$(NH_4)_2Cr_2O_7$ (10 marks)

$\boxed{30 \text{ marks}}$

(c). $2KMnO_4 + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O + 2K^+$

(15marks)

molar ratio, $KMnO_4 : C_2O_4^{2-}$

2 : 5

number of moles of $C_2O_4^{2-}$ consumed to titrate 25cm³ of the solution $\Big\} = \frac{0.02 \times 15}{1000}$

$= 3\times10^{-4}mol$

∴ The number of $KMnO_4$ present in 25cm³ of the solution $\Big\} = \frac{3\times10^{-4}mol \times 2}{5}$

$= 1.2\times10^{-4}mol.$

The number of moles of $KMnO_4$ present in $100\ cm^3$ of the solution $\Big\}$ $= \frac{1.2 \times 10^{-4}\ mol}{25\ cm^3} \times 100\ cm^3$

$= 4.8 \times 10^{-4}\ mol$

∴ The mass of $KMnO_4$ present in the sample. $= 4.8 \times 10^{-4}\ mol \times 158\ g\ mol^{-1}$

$= 0.07584\ g$

$= 75.84\ mg$

mass percentage of $KMnO_4$ $= \frac{75.84\ mg}{200\ mg} \times 100\%$

$= 37.92\%$

(11 x 5 marks = 55)

$\boxed{70\ \text{marks.}}$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