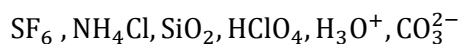**Part - II**

Structure Questions- A

❖ **Answer all questions.**

❖ **Each question carries 100 marks)**

01. a) Consider the following chemical species given in the list and answer the following questions.

$$SF_6, NH_4Cl, SiO_2, HClO_4, H_3O^+, CO_3^{2-}$$

   i.   Identify the species which has a shape similar to the shape of NCl_3 (.....................)

   ii. Identify the species which has the heighest number of lone pair   (....................)

   iii. Identify the species which exhibits both ionic and covalent character   (....................)

   iv. Identify the species which has the highest melting point   (....................)

   v.   Identify the species which has the bond angle 120^0 (....................)

   vi. Identify the species which has the highest oxidation number +7 in the central atom

                                                                                    (....................)

   b) i. Draw the most acceptable Lewis dot – dash structure for the molecule $C_2H_3O_3N$. Its skelton is given below.

$$
\begin{array}{c}
\qquad\qquad\quad O \\
\qquad\qquad\quad | \\
H-O-N-C-C-O-H \\
\qquad\qquad | \\
\qquad\qquad H
\end{array}
$$

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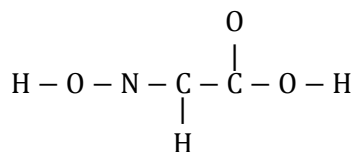
   ii. The most stable Lewis dot – dash structure for the ion $[HS_2O_5]^-$ is shown below.

   Draw three more Lewis dot – dash structures (Resonance structures) for this ion .

$$
\begin{array}{c}
\quad :O: \; :O: \\
\quad \| \quad \| \\
H-\ddot{O}-S-S-\ddot{O}:^- \\
\quad \| \quad \\
\quad :O:
\end{array}
$$

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iii. Based on Lewis dot – dash structure given below. State the following regarding the C, N and O atoms given in the table.

    I.   VSEPR pair around the atoms

    II. electron pair geometry around the atom

    III. Shape around the atom.

    IV. hybridization around the atom

The atoms are numbered as follows.

$$H - \underset{\underset{H}{|}}{C} = \underset{\underset{H}{|}}{C} - \underset{\underset{H}{|}}{\overset{..}{N}} - \underset{\underset{:\overset{..}{O}:}{||}}{C} - \overset{..}{\underset{..}{O}} - H \quad ; \quad H - \underset{\underset{H}{|}}{C^1} - \underset{\underset{H}{|}}{C^2} - \underset{\underset{H}{|}}{N^3} - \underset{\underset{O^6}{||}}{C^4} - O^5 - H$$

	C^1	N^3	C^4	O^5
I. VSEPR pair				
II. Electron pair geometry				
III. Shape				
IV. Hybridization				

iv. Identify the atomic / hybride orbitals involved in the formation of the following σ bonds in the Lewis dot – dash structure given in part (iii) above.

    I. $C^1 - C^2$ C^1 .... C^2 ....

    II. $C^2 - N^3$ C^2 .... N^3 ....

    III. $N^3 - C^4$ N^3................................ C^4................................

    IV. $C^4 - O^5$ C^4................................ O^5................................

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

(v) Identify the atomic orbitals involved in the formation of the following π bonds in the Lewis dot – dash structure give in part (iii) above

    I. $C^1 - C^2$ C^1 .... C^2 ....

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

c) (i) Select two polar species from the list given below.

$$I_3^-, \quad CCl_4, \quad SF_4, \quad SO_3, \quad CO$$

………………….and ………………………

(ii) State the type(s) of intermolecular forces that exist between the molecules in each of the following.

    1. $NaCl_{(s)}$ and excess water   ....

    2. $Br_{2(l)}/ CCl_{4(l)}$ ....

    3. $KI_{(aq)}$ and $I_{2(s)}$ ....

    4. $Cl_{2(g)}$ and water   ....
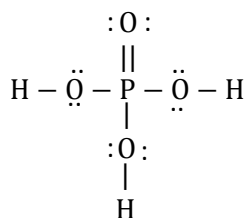
02. a)

i. A 1.500 g sample of an organic compound containing only C, H, and O was burned completely. The only combustion products were 1.738 g CO_2 and 0.711 g H_2O. What is the empirical formula of the compound. (C = 12, H = 1, O = 16)

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ii. Relative molar mass of the sample A is 152, Write the molecular formula of the sample A.

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b) i. Consider the Lewis dot – dash structure of H_3PO_4 to answer the following questions from. (I) to (IV).

$$H - \overset{..}{\underset{..}{O}} - \overset{\displaystyle :O:}{\overset{\displaystyle \|}{\underset{\displaystyle \overset{|}{\underset{H}{:O:}}}{P}}} - \overset{..}{\underset{..}{O}} - H$$

deduce the shapes around the following atoms using the VSEPR theory.

I.   P

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II.   O attached to H.

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III.   Sketch the shape of the Lewis structure given above (i) showing approximate bond angle.

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IV.   Calculate the charge of phosphorus (P) in the structure H_3PO_4 given above (i)

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c) (i) A is an element of Third period in the periodic table. Its first eight Ionization energies in $kJmol^{-1}$ are 1260, 2300, 3850, 5150, 6540, 9330, 11000, 33600 respectively.
1. Identify the element A.

....

2. Write the electronic configuration of A

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3. Write the common oxidation states of A in its compounds. (need not write compounds)

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4. Give the example of a compound 'A' which has lowest oxidation number.

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03. a   The following question is regarding the reaction between $KMnO_4$ and FeC_2O_4 solutions in acidic medium.

(i) Write the half ionic equation for the reduction.

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(ii) Write the half ionic equation / s for oxidation.

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(iii) Write the complete ionic reaction.

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(iv) Using the complete ionic reaction, write the chemical reaction between $KMnO_{4(aq)}$ and $FeC_2O_{4(aq)}$ using dilute H_2SO_4

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(v) A solution was prepared by dissolving 0.948 g of $KMnO_4$ in dilute H_2SO_4. At proper temperature, calculate the volume of 0.2 $moldm^{-3}FeC_2O_4$ solution needed to react completely with the above $KMnO_4$ solution.

(K – 39, Mn – 55, O – 16)

Note – Assume that the Fe^{2+} in FeC_2O_4 solution does not get oxidized in the FeC_2O_4 solution at ordinary condition

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b) Balance the following equations and state which of the elements in the reactant underlined, changes it's oxidation state. (From which oxidation state to which oxidation)

i. $H^+ + \underline{IO_3^-} + \underline{I^-} \longrightarrow I_2 + H_2O$

....

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ii. $Mg + \underline{HNO_3} \longrightarrow Mg(NO_3)_2 + NH_4NO_3 + H_2O$

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iii. $NaOH + \underline{Cl_2} \longrightarrow NaCl + NaClO_3 + H_2O$

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iv. $\underline{H_2S} + \underline{SO_2} \longrightarrow S + H_2O$

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04. a) i. What do you understand by empirical formula?

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ii. A compound contains C - 53.93 %, H – 12.35 %, O – 17.97% and N – 15.73%. If the mass of the empirical formula is 89. Find the empirical formula.

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iii. If the empirical formula and molecular formula are equal, find the molar mass

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b) In the laboratory, you are provided with solid dried Na_2CO_3 and other apparatus. 250 cm^3 of $0.1 \text{ moldm}^{-3} Na_2CO_3$ solution is to be prepared.

i. Write the list of chemicals and apparatus needed

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i. Using proper calculations, state how 250 cm^3 of $0.1 \text{ moldm}^{-3} Na_2CO_3$ could be prepared.

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Grade – 12 (2021)	**Chemistry II**	

Part –II
Structure Question –B

Answer two questions only.

05.

   i. Give four evidences to show that cathode rays have energy.

   ii. Give three observations in Rutherford's gold leaf experiment.

   iii. What is electromagnetic spectrum?

   iv. State the four types of quantum numbers and Explain what each of them indicate.

   v. State three characteristics of resonance.

   vi. State two informations each that could be obtained directly and that cannot be obtained directly from Lewis structures.

   vii. State the ionic properties of $MgCl_2$, $CaCl_2$, $SrCl_2$ and $BaCl_2$ and give reasons.

   viii. State the electro negativities of sulphur in H_2S, SO_3^{2-}, SO_4^{2-} in descending order and give reason.

06. a) i. Find the mole fraction of NaOH in a 10% of NaOH solution by mass?
       [Na – 23 $gmol^{-1}$, O - 16 $gmol^{-1}$, H - 1 $gmol^{-1}$]

   ii. 4 mg of Na_3PO_4 present in 2 kg of sea water. Give the composition of Na_3PO_4 in ppm.

   iii. Give four characteristic features of primary standard solution.

   iv. Find the mass of O in 32 g of Fe_2O_3
       [Molar mass of Fe and O are 56 $gmol^{-1}$ and 16 $gmol^{-1}$]

   b) An organic compound containing C, H and O only, It contains C = 54.55%. If the molar mass of this compound is 88$gmol^{-1}$, find the molecular formula
   [molar masses of C, H and O are 12 $gmol^{-1}$, 1 $gmol^{-1}$, 16 $gmol^{-1}$ respectively]

   c) Using calculation, explain how $600 \, cm^3$, $2.3 \, moldm^{-3}$, H_2SO_4 solution could be prepared using concentrated H_2SO_4 solution having 98% $(^W/_W)$ by mass and density 1.84 gcm^{-3}
   [molar mass of H_2SO_4 is 98 $gmol^{-1}$]

07.

    i)   Boiling point of NO is higher than that of O_2. Explain

    ii)   State three factors that contributes to the strength of metallic bond.

    iii) 0.48 g Mg and 0.14 g N_2 reacts to form Mg_3N_2. Identify the limiting reactant with calculation.

         [molar masses of Mg and N are 24gmol^{-1}, 14gmol^{-1} respectively]

    iv) 100 cm^3 of $Ba(OH)_2$ is added to 100 cm^3 of $20 \times 10^{-3} \text{moldm}^{-3}$ HCl to completely react.

         To the resulting solution Cl^- ions were completely precipitated by the addition of $AgNO_3$

         a)   Write balanced equations for the reactions that take place.

         b)   Find the concentration of $Ba(OH)_2$ needed.

         c)   Calculate the mass of AgCl formed.

           [Ag -108 gmol^{-1},Cl- 35.5gmol^{-1}]

    v)   1.25 g of powdered limestone was reacted with 30 cm^3 1 moldm^{-3}HCl. Then remaining HCl

         was reacted with 1 moldm^{-3} NaOH. Volume of NaOH needed to completely react is 10 cm^3.

         Find the mass percentage of $CaCO_3$ in limestone

         [Molar mass of Ca, C and O are 40, 12 and 16 gmol^{-1}]

         Hint :-

         $CaCO_3 + HCl \longrightarrow CaCl_2 + CO_2 + H_2O$ **not balanced**