**SAFAL EDUCATION ACADEMY**
**STANDARD – XI**
**CHEMISTRY**
**[Paper – 7]**

TIME : 1.0 Hr MARKS : 55
NAME : _____ Marks Obtained : ____

## Section – 1 (Redox Reactions) [17]

Q – 1 Solve the following [5]

1. When a copper wire is placed in a solution of AgNO3, the solution acquires blue colour. This is due to
   (a)oxidation of Cu (b)reduction of Cu (c)formation of a soluble complex (d)oxidation of Ag
2. Oxygen has an oxidation state of +2 in
   (a) H2O2 (b) H2O (c) OF2 (d) SO2
3. Which atom in the following reactions undergoes a change of oxidation state of -5?
   (a) $MnO_4 \rightarrow Mn^{2+}$ (b) $Cr_2O_7^{2-} \rightarrow 2Cr^{3+}$ (c) $MnO_4^- \rightarrow MnO_2$ (d) $CrO_4^{2-} \rightarrow Cr^{3+}$
4. The oxidation state of Cr in $[Cr(NH_3)_4Cl_2]^+$ is
   (a)0 (b) +1 (c)+2 (d)+3
5. Oxidation states of P in H4P2O5, H4P2O6, H4P2O7, are respectively
   (a) +3, +5, +4 (b) +5, +3, +4 (c) +5, +4, +3 (d) +3, +4, +5.

Q – 2 Answer the following [12]

1. Calculate the oxidation number of the underlined atoms in the following species.
   NH2OH, [CO(NH3)5Cl]Cl2, (N2H5)2 SO4, Mg3N2
2. Balance the following equations
   (1) $C_2H_5OH + I_2 + OH^- \rightarrow CHI_3 + HCOO^- + I^- + H_2O$ (basic medium) (oxidation number method)
   (2) $NO_3^- + H_2S \rightarrow HSO_4^- + NH_4^+$ (Ion electron method)
   (3) $KMnO_4 + H_2SO_4 + H_2C_2O_4 \rightarrow K_2SO_4 + MnSO_4 + CO_2 + H_2O$ (oxidation number method)
   (4) $Cu + HNO_3 \rightarrow Cu(NO_3)_2 + NO + H_2O$ (oxidation number method)
   (5) $MnO_4^- + H_2O \rightarrow MnO_4^- + MnO_2 + OH^-$ (Ion electron method)



## Section – 2 (Chemical Bonding) [38]

Q – 1 Solve the following [8]

1. If the electron pair forming a bond between two atoms A and B is not in the centre, then the bond is :
   (a) single bond (b) polar bond (c) non-polar bond (d) π-bond
2. Energy required to dissociate 4 g of gaseous hydrogen into free gaseous atoms is 208 kcal at 25°C. The bond energy of H – H bond will be:
   (a) 104 k cal (b) 10.4 kcal (c) 1040 k cal (d) 1.04 kcal
3. Which one of the following molecules does not possess a permanent electric dipole moment?
   (a) H2S (b) SO2 (c) CS2 (d) SO3
4. Resonance occurs due to:
   (a) delocalisation of lone pair of electrons (b) delocalisation of σ electrons
   (c) delocaiisation of π electrons (d)oscillation of a proton

5. Which one of the following groupings represents a collection of isoelectronic species? (At. No.: Cs-55, Br-35 )
   (a) Na+, Ca2+, Mg2+ (b) N3–, F–, Na+ (c)Be, Al3+, Cl– (d) Ca2+, Cs+, Br
6. The bond order in the species $O_2$, $O_2^+$ and $O_2^-$ follows the order:
   (a) $O_2 > O_2^+ > O_2^-$ (b) $O_2^+ > O_2 > O_2^-$ (c) $O_2^- > O_2 > O_2^+$ (d) $O_2^+ > O_2^- > O_2$
7. Which has the bond order- ½?
   (a) $O_2$ (b) $N_2$ (c) $F_2$ (d) $H_2^+$
8. Which of the following is diamagnetic?
   (a.) $O_2^+$ (b) $O_2$ (c) $O_2^-$ (d) $O_2^{2-}$

Q – 2 Answer the following [10]

1. How many singlet linkages are present in the Sugden's structure of SF6?
2. Among AgCl and AgI, which is more covalent?
3. What type of orbitals can overlap to form a covalent bond?
4. What happens to the potential energy of the system when two atoms form a covalent bond?
5. Is hybridization between the orbitals of two atoms possible?
6. What type of bond is formed when two ρ-orbitals overlap axially?
7. What is a kernel and how is it formed?
8. Why does $He_2$ not exist?
9. Out of σ and π-bonds, which bond is stronger and why?
10. Arrange the following molecular species in increasing order of stability (giving bond orders) : $O_2$, $O_2^+$, $O_2^-$, $O_2^{2-}$



Q – 2 Answer the following [20]

1. Discuss the factors which govern the formation of a covalent bond
2. What is variable covalency? Give some examples.



3. What are Sidgwick's views regarding the failure of the octet rule?
4. What are Fajan's rules?
5. Define dipole moment. How is it related to the molecular structure?
6. What is lattice energy and how is it related to the stability of anionic compound?
7. What are the main points of difference between σ and π orbitals?
8. Give the molecular orbital description of hydrogen molecule and deduce the bond order.
9. Explain on the basis of molecular orbital diagram why $O_2$ should be paramagnetic.
10. On the basis of VSEPR theory explain why $BeCl_2$ molecule is linear whereas $H_2O$ is angular.

# ANSWERS

## Section – 1 (Redox Reactions) [23]

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   (a) +3, +5, +4 (b) +5, +3, +4 (c) +5, +4, +3 (d) +3, +4, +5.

Q – 2 Answer the following [12]

1. Calculate the oxidation number of the underlined atoms in the following species.
   NH2OH, [CO(NH3)5Cl]Cl2, (N2H5)2 SO4, Mg3N2 [Ans.-l. +3, -2, +2]
2. Balance the following equations
   (6) $C_2H_5OH + I_2 + OH^- \rightarrow CHI_3 + HCOO^- + I^- + H_2O$ (basic medium) (oxidation number method)
   $C_2H_5OH + 4I_2 + 6OH^- \rightarrow CHI_3 + HCOO^- + 5I^- + 5H_2O$ (Answers)
   (7) $NO_3^- + H_2S \rightarrow HSO_4^- + NH_4^+$ (Ion electron method)
   $NO_3^- + H_2S + H^+ + H_2O \rightarrow HSO_4^- + NH_4^+$ (Ans)
   (8) $KMnO_4 + H_2SO_4 + H_2C_2O_4 \rightarrow K_2SO_4 + MnSO_4 + CO_2 + H_2O$ (oxidation number method)
   $2KMnO_4 + 3H_2SO_4 + 5H_2C_2O_4 \rightarrow K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O$ (Answer)
   (9) $Cu + HNO_3 \rightarrow Cu(NO_3)_2 + NO + H_2O$ (oxidation number method)
   $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$ (Answer)
   (10) $MnO_4^- + H_2O \rightarrow MnO_4^- + MnO_2 + OH^-$ (Ion electron method)
   $3MnO_4^- + 2H_2O \rightarrow 2MnO_4^- + MnO_2 + 4OH^-$ (Ion electron method)



## Section – 2 (Chemical Bonding) [37]

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7. Which has the bond order- ½?
   (a) $O_2$ (b) $N_2$ (c) $F_2$ (d) $H_2^+$
8. Which of the following is diamagnetic?
   (a.) $O_2^+$ (b) $O_2$ (c) $O_2^-$ (d) $O_2^{2-}$

Q – 2 Answer the following [12]

1. How many singlet linkages are present in the Sugden's structure of SF6?
   Four
2. Among AgCl and AgI, which is more covalent?
   AgI
3. What type of orbitals can overlap to form a covalent bond?
   Half-filled orbital
4. What happens to the potential energy of the system when two atoms form a covalent bond?
   Potential energy decreases
5. Is hybridization between the orbitals of two atoms possible?
   No
6. What type of bond is formed when two ρ-orbitals overlap axially?
   σ bond
7. What is a kernel and how is it formed?
   When an atom loses one or more of its valence electron, the remaining part of the atom left is called core or kernel.
8. Why does $He_2$ not exist?
   The bond order for $He_2$ is zero. Hence, the molecule cannot exist.
9. Out of σ and π-bonds, which bond is stronger and why?
   σ bond, due to a greater overlapping of atomic orbitals.
10. Arrange the following molecular species in increasing order of stability (giving bond orders) : $O_2$, $O_2^+$, $O_2^-$, $O_2^{2-}$
    $O_2^{2-} < O_2^- < O_2 < O_2^+$ B.O. 1, 3/2, 2, 5/2

Q – 2 Answer the following [22]

1. Discuss the factors which govern the formation of a covalent bond
   The factors are :
   (i) High value of ionization
   (ii) equal electron gain enthalpy

(iii) Equal electronegativities

2. What is variable covalency? Give some examples.

   In an excited state, the atom has more probability of sharing its unpaired electron with those of other atoms.

3. What are Sidgwick's views regarding the failure of the octet rule?

   According to sidgwick, it is not always necessary for an atom to achieve an octet. He put forward his views in the form of a concept called concept of maximum covalency. In this, the maximum covalency of an atom is governed by its position in periodic table. The maximum covalency of an atom can be less than four as well as it can exceed four.

4. What are Fajan's rules?

   The Fajan's rules are :

   (i) Smaller size of cation and greater the size of anion, greater is the extent of polarization in an ionic compound.

   (ii) Larger the charge on cation and anion, greater is the extent of polarization in an ionic compound.

   (iii) Higher is the dielectric constant of the medium, lesses is the extent of polarization in an ionic compound.

5. Define dipole moment. How is it related to the molecular structure?

   Dipole moment is defined as the product of magnitude of the charge present on either of the two atoms and the distance by which the two atoms are separated in the molecule.

   Since the dipole moment is a vector quantity, the net dipole moment of a molecule is the resultant of the dipole moments of all the polar bonds present in it.

6. What is lattice energy and how is it related to the stability of anionic compound?

   The amount of energy liberated in condensing the required number of cations and anions to form the lattice of one gram mole of an ionic compound is called the lattice energy of that compound.

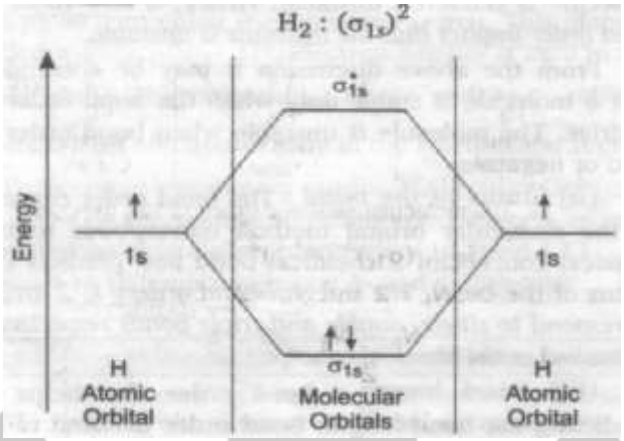
   The magnitude of lattice energy gives an idea of the inter ionic forces. It depends upon two factors: (i) Smaller the size of ions, greater is the lattice energy, (ii) Higher the charge on the ions, greater is the lattice energy. Lattice energy is regarded as a measure of ease of formation and stability of an ionic compound.

7. What are the main points of difference between σ and π orbitals?

| **σ molecular orbitals** | | **π molecular orbitals** | |
|---|---|---|---|
| 1 | It is formed by head on (along inter-nuclear axis) overlapping of atomic orbitals. | 1 | It is formed by the side wise (perpendicular to the inter-nuclear axis) overlapping of atomic orbitals. |
| 2 | The overlapping of atomic orbitals is maximum. | 2 | The overlapping of atomic orbitals is much less. |
| 3 | The orbital is symmetrical to rotation about the internuclear axis. | 3 | The orbital is not symmetrical to rotation about the internuclear axis. |
| 4 | The resulting covalent bond is strong. | 4 | The resulting covalent bond is weaker. |

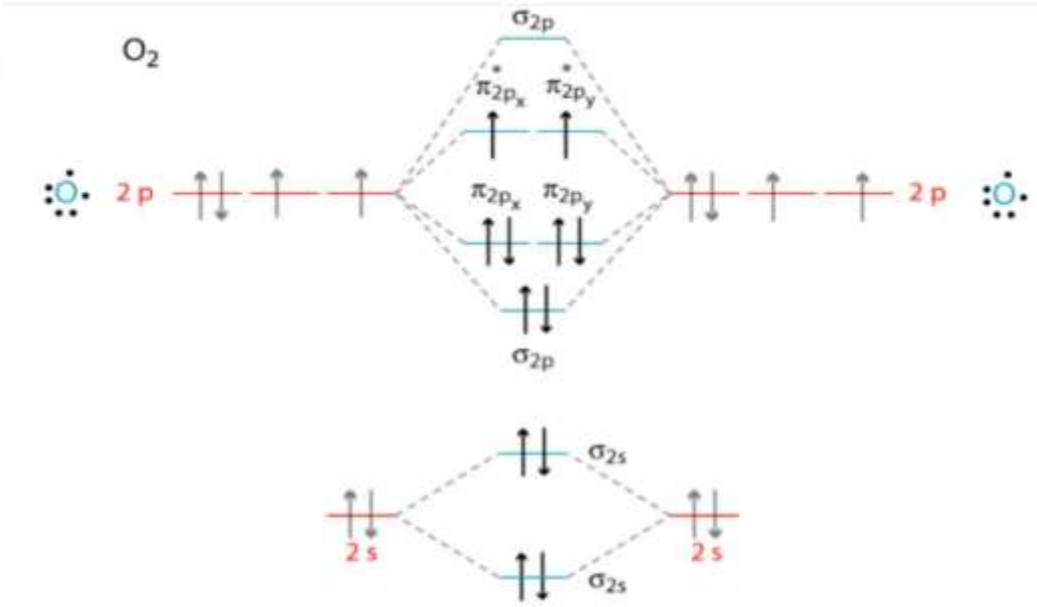
8. Give the molecular orbital description of hydrogen molecule and deduce the bond order.

Hydrogen molecule ($H_2$) is formed by the combination of two hydrogen atoms. Hydrogen atom ($1s^1$) contains only one electron in ls-atomic orbital. $H_2$ molecule will thus possess two electrons. At a certain internuclear distance, the ls-atomic orbitals of the two combining H-atoms overlap to form $\sigma_{1s}$ and $\sigma^*_{1s}$ molecular orbitals. According to aufbau principle, the two electrons of the combining hydrogen atoms should be placed in the low energy $\sigma_{1s}$ orbital. The high energy $\sigma^*_{1s}$ orbital remains vacant. The molecular orbital electronic configuration of H2 molecule is therefore $(\sigma_{1s})^2$.




$$\text{Bond order} = \frac{N_b - N_a}{2} = \frac{2-0}{2} = 1.$$

9. Explain on the basis of molecular orbital diagram why $O_2$ should be paramagnetic.




Electron Configuration: $(\sigma_{2s})^2\ (\sigma_{2s}^*)^2\ (\sigma_{2p})^2\ (\pi_{2p})^4\ (\pi_{2p}^*)^2$

Bond Order $= \frac{1}{2}(2 - 2 + 2 + 4 - 2) = 2$ Double Bond

From the molecular orbital diagram of $O_2$ shown in Fig., it is clear that the aufbau order of filling of molecular orbitals leaves two unpaired electrons, one each in $\pi^*_{2Px}$ and $\pi^*_{2py}$ molecular orbitals. Thus, a $O_2$ molecule possesses two unpaired electrons even in the ground state. The unpaired electrons impart paramagnetic character to oxygen molecule. Thus, $O_2$ molecule should be paramagnetic in nature.

10. On the basis of VSEPR theory explain why $BeCl_2$ molecule is linear whereas $H_2O$ is angular.

In $BeCl_2$, the central Be atom possesses two bond pairs of electrons. These pairs repel each other to the maximum possible extent and get oriented at an angle of $180^o$. Therefore, $BeCl_2$ molecule acquires a linear shape.

In $H_2O$, the two lone pairs of electrons present on the central atom strongly repel the O-H bond pairs. Since lone pair-bond pair repulsion is more than the bond paie-bond pair repulsion, the normal angle of 109° 28' in a tetrahedral geometry decreases to 104.5° and the tetrahedral geometry gets distorted. The resulting geometry is regarded as bent or angular.