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

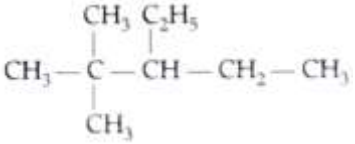
TIME : 1.0 Hr MARKS : 80

NAME : _____ Marks Obtained : ____

Section – 1 (Organic Chemistry) [40]

Q – 1 Answer the following [One mark each] [10]

1. Identify primary, secondary, tertiary and quaternary carbon atoms in the following compound:

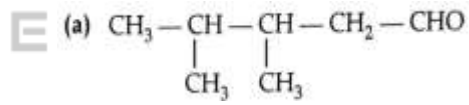


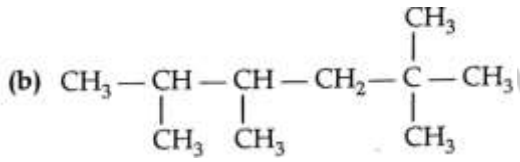
2. Name the following compound?

3. What is the functional isomer of ethanol ?
4. How many chain isomers are possible with the formula C_7H_{16}?
5. Out of cis and trans isomers, which isomer is more stable?
6. What is the main cause of geometrical isomerism?
7. Name the prism passing through which ordinary light changes into plane polarized light.
8. What is the necessary and sufficient condition for a molecule to be optically active?
9. In which direction does a d-isomer rotate the plane of plane polarized light?
10. What type of isomerism is shown by isopentane and neopentane?

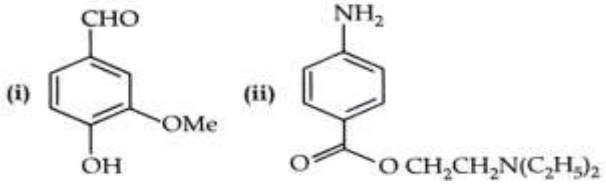
Q – 2 Answer the following [Two marks each] [12]

1. Write the IUPAC name of following compounds:

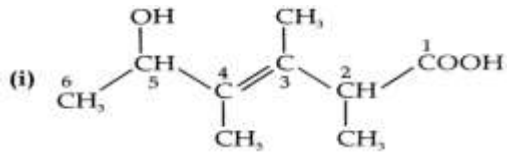




2. Identify the functional groups in the following compounds



3. Write the bond line notation of :



(ii) 5,6-diethyl-3-methyldec-4-ene
(ii) 3-methylcyclobutan-1-ol

4. Define specific rotation.
5. What is meant by chirality? Explain with an example.
6. What do you understand by racemic mixture and why does it have no effect on plane polarized light?

Q – 3 Answer the following [Three marks each] [18]

1. Write the IUPAC name of following compounds:
   (a) CH_3CH_2COOH, (b) $HOCH_2CH_2OH$, (c) $CH_2 = CH – CH = CH_2$
2. Give condensed and bond line structural formulae and identify the functional group(s) present, if any, for:
   (i) 2, 2, 4-trimethylpentane, (ii) 2-hydroxy- 1, 2, 3-propanetricarboxylic acid

3. Draw the structure of the following: (i) 3-ethyl-4,5-dimethylhexan-1-oic acid, (ii)Butane-1,4-dinitrile, (iii) 3,3-dimethylpentane-2,4-dione
4. Draw structures of all isomers of tartaric acid ($C_4O_6H_6$). Which amongst these isomers is optically inactive?
5. What are diastereoisomers? Mention their important properties.
6. What are the characteristics of tautomeric changes?

Section – 2 (Some Basic Concept of Chemistry) [8]

Q – 1 Solve the following [8]

1. A sugar syrup of weight 214.2 g contains 34.2 g of sugar (C12H22011). Calculate (i) molal concentration (i) mole fraction of sugar in the syrup.
2. A sample of sodium carbonate contains impurity of sodium sulphate. 1.25 g of this sample are dissolved in water and volume made up to 250 ml. 25 ml of this solution neutralise20 ml of 0.1N sulphuric acid. Calculate the percentage of sodium carbonate in the sample.
3. In a Victor Meyer's determination, 0.36 g of volatile substance displaces air which measures 140ml at STP Calculate the vapour density and molecular weight of the substance. (1litre of H, gas at STP weighs 0.09 g)
4. 0.246 g of an organic substance when heated with excess of fuming nitric acid and silver nitrate gave 0.2584 g of silver bromide. Calculate the percentage of bromine in the compound.

Section – 3 (Redox Reaction) [10]

Q – 1 Find the oxidation number of: [2]

1. Cr in K2Cr2O7, (2) Mn in K2MnO4

Q – 2 Balance the redox reaction using given method [8]

1. $K_2Cr_2O_7 + HCI \rightarrow KCl + CrCl_3 + H_2O + CI_2$ (Oxidation number method)
2. $Cr(OH)_3 + IO_3^- + OH^- \rightarrow CrO_4^- + I^- + H_2O$ (Ion electron method)
3. $C_2H_5OH + I_2 + OH- \rightarrow CHI_3 + HCOO^- + I^- + H_2O$ (Basic medium) (Oxidation number method)
4. $NO_3^- + H_2S \rightarrow HSO_4^- + NH_4^+$ (Ion electron method)

Section – 4 (Chemical Bonding) [32]

Q – 1 Answer the following [5]

1. What type of bond is formed when two ρ-orbitals overlap axially?
2. What is a kernel and how is it formed?
3. Why does He_2 not exist?
4. Out of σ and π-bonds, which bond is stronger and why?
5. Arrange the molecular species in increasing order of stability (giving bond orders) : O_2, O_2^+, O_2^-, O_2^{2-}

Q – 2 Answer the following [27]

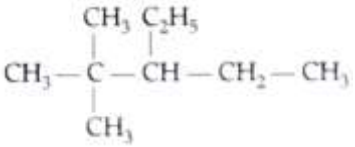
1. Explain on the basis of molecular orbital diagram why O_2 should be paramagnetic.
2. What are Fajan's rules?
3. Calculate the heat of formation of NaCl from the following data:
   Heat of sublimation of sodium = 108.5 kJ mol^{-1}
   Dissociation energy of chlorine = 243.0 kJ mol^{-1}
   lonization energy of sodium = 495.8 kJ mol^{-1}
   Electron gain enthalpy of chlorine = -348.8 kJ mol^{-1}
   Lattice energy of sodium chloride = -758.7 k] mol^{-1}
4. Explain the structure of $PC1_5$ molecule, using Sugden's concept.
5. On basis of VSEPR theory, predict the bond angles in the following molecules: $BeCl_2$, PH_3, OF_2, BF_3, SiH_4,
6. Write a short note on dipole moment, its unit and its significance.
7. Explain the formation of CH, molecule?
8. Write the molecular orbital configuration, bond order and predict the magnetic behaviour of the following species: O_2, O_2^+, O_2^-, O_2^{2-}
9. Draw the structure of ethylene and acetylene molecule, showing: (a) overlapping of orbitals (b) o and n bond and bond angles

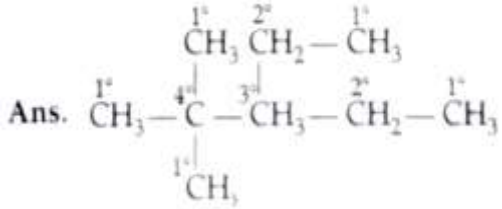
ANSWERS

Section – 1 (Organic Chemistry) [40]

Q – 1 Answer the following [One mark each] [10]

1. Identify primary, secondary, tertiary and quaternary carbon atoms in the following compound:





Ans.

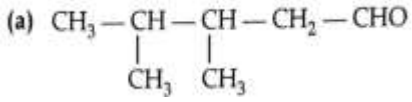
2. Name the following compound?

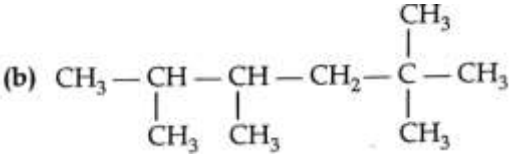
Ans. But-1, 3-diene.

3. What is the functional isomer of ethanol ?
   Methoxymethane
4. How many chain isomers are possible with the formula C_7H_{16}?
   Nine
5. Out of cis and trans isomers, which isomer is more stable?
   Trans
6. What is the main cause of geometrical isomerism?
   Restricted rotation of carbon atoms about a double bond
7. Name the prism passing through which ordinary light changes into plane polarized light.
   Nicol prism
8. What is the necessary and sufficient condition for a molecule to be optically active?
   Chirality
9. In which direction does a d-isomer rotate the plane of plane polarized light?
   Clockwise
10. What type of isomerism is shown by isopentane and neopentane?
    Structural

Q – 2 Answer the following [Two marks each] [12]

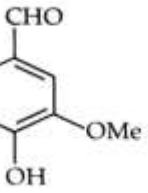
1. Write the IUPAC name of following compounds:

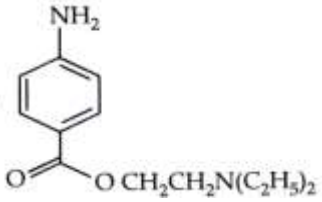




Ans. (a) 3, 4-dimethyl -pentan-1-al (b) 2, 2, 4, 5-tetramethylhexane.

2. Identify the functional groups in the following compounds

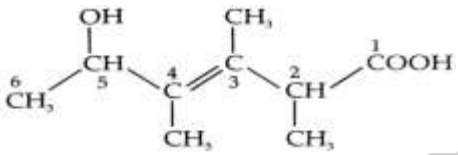
(i) 

(ii) 

Ans. **(i)** –CHO (Aldehydes), –OH (Alcohol), $-OCH_3$ (ether)

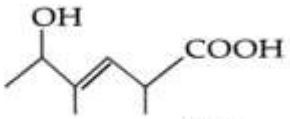
(ii) $-NH_2$ (10 amine, aromatic), –C = O–O– (ester) and $-N(C_2H_5)_2$ 3° amine

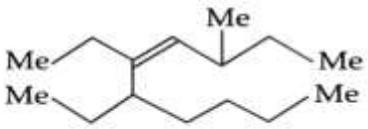
3. Write the bond line notation of :

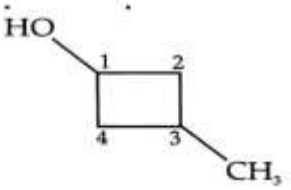
(i) 

(ii) 5,6-diethyl-3-methyldec-4-ene

(ii) 3-methylcyclobutan-1-ol

Ans. **(i)** 

(ii) 

(iii) 

4. Define specific rotation.

Specific rotation is number of observed degree of rotation caused by an optically active substance when plane polarized light is passed through one decimeter of its solution having concentration one gram per mililitre. The specific rotation of a substance is represented by $[\alpha]^t_D$, where t stands for temperature and D for D-line of sodium light. It may be calculated by the following expression

$$[\alpha]^t_D = \frac{\alpha_{obs.}}{l \times c}$$

Where, *l* represents the length of the solution in decimetres, and c is the concentration of the substance in gm/cm^3. The direction of rotation of light rnay be specified by putting a + (for clockwise rotation) or- (for anticlockwise rotation), sign, in the value of specific rotation.

5. What is meant by chirality? Explain with an example.

The term chirality is derived from the Greek word Kheir which means hand. Thus, the term chirality means having handedness i.e., being left handed or right handed. When an object is non-superimposable on its mirror image, it is said to be chiral. Chirality is also known as dissymmetry. Some common examples of chiral objects are a pair of hands, a pair of shoes, a pair of gloves and some of the alphabets like P, F, J, etc.

6. What do you understand by racemic mixture and why does it have no effect on plane polarized light?

   A mixture containing equal amounts of d- and l-isomers of a substance is called racemic mixture. Racemic mixture has no effect on plane polarized light because it has an equal but opposite effect on plane polarized light.

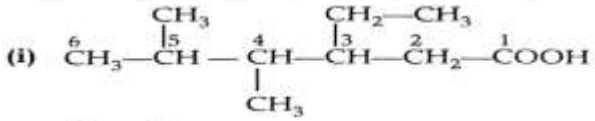
Q – 3 Answer the following [Three marks each] [18]

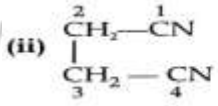
1. Write the IUPAC name of following compounds:
   (b) CH_3CH_2COOH
   (c) $HOCH_2CH_2OH$
   (d) $CH_2 = CH – CH = CH_2$
   Answer
   Ans. (a) Propanoic acid, (c) Ethanediol, (d) But 2- yne 1- ol.
2. Give condensed and bond line structural formulae and identify the functional group(s) present, if any, for:
   (i) 2, 2, 4-trimethylpentane, (ii) 2-hydroxy- 1, 2, 3-propanetricarboxylic acid

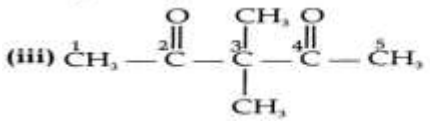
Ans. (a) (i) Condensed formula : $(CH_3)_3CCH_2CH(CH_3)_2$
Bond-line formula :

Functional group (s) present : Nil

3. Draw the structure of the following: (i) 3-ethyl-4,5-dimethylhexan-1-oic acid, (ii)Butane-1,4-dinitrile, (iii) 3,3-dimethylpentane-2,4-dione
   Answer

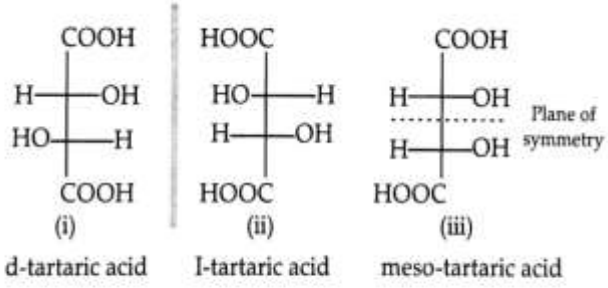






4. Draw the structures of all the isomers of tartaric acid ($C_4O_6H_6$). Which amongst these isomers is optically inactive?

Ans.



Stereoisomers of tartaric acid

Meso tartaric acid is optically inactive.

They are optically inactive because the net optical rotation caused by them is zero due to internal compensation.

5. What are diastereoisomers? Mention their important properties.

   The optical isomer of a compound which are not the mirror image of each other. The properties of diastereoisomers are :

   (1) They differ in physical properties.

   (2) Chemical properties of diastereoisomers are similar but their rates of reaction with other optically active substance may be different.

   (3) Their mass spectra and N.M.R spectra may also be different.

6. What are the characteristics of tautomeric changes?

   (1) It is caused by the wandering of a hydrogen atom between two polyvalent atoms present in molecule.

   (2) It is a reversible intramolecular change.

   (3) The two tautomerism forms are not equally stable.

Section – 2 (Some Basic Concept of Chemistry) [8]

Q – 1 Solve the following [8]

1. A sugar syrup of weight 214.2 g contains 34.2 g of sugar ($C_{12}H_{22}O_{11}$). Calculate (i) molal concentration (i) mole fraction of sugar in the syrup. (Ans 0.56m, mol fraction - 0.0099)
2. A sample of sodium carbonate contains impurity of sodium sulphate. 1.25 g of this sample are dissolved in water and volume made up to 250 ml. 25 ml of this solution neutralise20 ml of 0.1N sulphuric acid. Calculate the percentage of sodium carbonate in the sample. (Ans 84.9)
3. In a Victor Meyer's determination, 0.36 g of volatile substance displaces air which measures 140ml at STP Calculate the vapour density and molecular weight of the substance. (1litre of H_2 gas at STP weighs 0.09 g)

Ans. Mass of 140 ml of vapour at STP = 0.36g

Mass of 22400 ml of vapour at STP

$$= \frac{22400 \times 0.36}{140} = 57.6g$$

$$\text{Vapour Density} = \frac{\text{molecular mass}}{2}$$

$$\text{Vapour Density} = \frac{57.6}{2} = 28.8$$

4. 0.246 g of an organic substance when heated with excess of fuming nitric acid and silver nitrate gave 0.2584 g of silver bromide. Calculate the percentage of bromine in the compound.

Ans. mass of organic compound = 0.246g
mass of AgBr formed = 0.2584g
molecular mass of AgBr = 108 + 80 = 188

$$188\text{g of AgBr contains Br} = \frac{80}{188} \times 0.2584$$

% age of Br in the given compound

$$= \frac{0.1099}{0.24} \times 100 = 44.67$$

Section – 3 (Redox Reaction) [10]

Q – 1 Find the oxidation number of: [2]

1. Cr in K2Cr2O7, (Ans +6)
2. Mn in K2MnO4 (Ans +6)

Q – 2 Balance the redox reaction using given method [8]

1. $K_2Cr_2O_7 + HCI \rightarrow KCl + CrCl_3 + H_2O + CI_2$ (Oxidation number method)
   K2Cr2O7 + 14HCI → 2KCl + 2CrCl3 + 7H2O + 3CI2
2. $Cr(OH)_3 + IO_3^- + OH^- \rightarrow CrO_4^- + I^- + H_2O$ (Ion electron method)
   $Cr(OH)_3 + IO_3^- + OH^- \rightarrow CrO_4^- + I^- + H_2O$
3. $C_2H_5OH + I_2 + OH^- \rightarrow CHI_3 + HCOO^- + I^- + H_2O$ (Basic medium) (Oxidation number method)
   $C_2H_5OH + 4I_2 + 6OH^- \rightarrow CHI_3 + HCOO^- + 5I^- + 5H_2O$
4. $NO_3^- + H_2S \rightarrow HSO_4^- + NH_4^+$ (Ion electron method)
   $NO_3^- + H_2S + H^+ + H_2O \rightarrow HSO_4^- + NH_4^+$

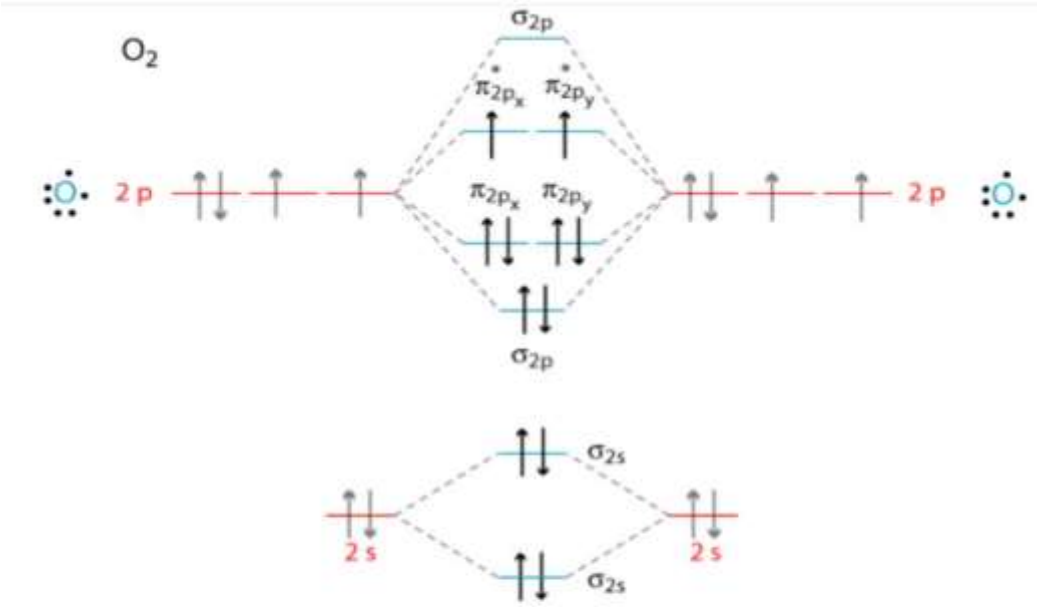
Section – 4 (Chemical Bonding) [32]

Q – 1 Answer the following [5]

1. What type of bond is formed when two ρ-orbitals overlap axially?
   σ bond
2. 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.
3. Why does He_2 not exist?
   The bond order for He_2 is zero. Hence, the molecule cannot exist.
4. Out of σ and π-bonds, which bond is stronger and why?
   σ bond, due to a greater overlapping of atomic orbitals.
5. 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 [27]

1. 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 π^*_{2Px} and π^*_{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.

2. 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.

3. Calculate the heat of formation of NaCl from the following data:

   Heat of sublimation of sodium = 108.5 kJ mol^{-1}

   Dissociation energy of chlorine = 243.0 kJ mol^{-1}

   lonization energy of sodium = 495.8 kJ mol^{-1}

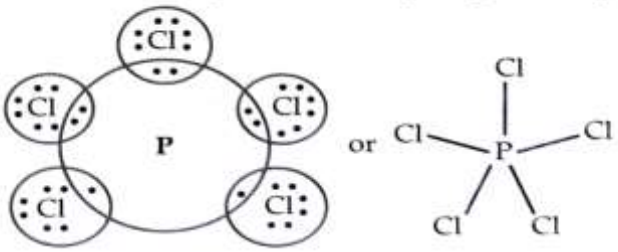
   Electron gain enthalpy of chlorine = -348.8 kJ mol^{-1}

   Lattice energy of sodium chloride = -758.7 k] mol^{-1}

Ans. $\Delta_{sub}H^\circ = 108.5$ kJ mol^{-1}
$\Delta_{diss}H^\circ = 243.0$ kJ mol^{-1}
IE $= 495.8$ kJ mol^{-1}
$\Delta_{eg}H^\circ = -348.8$ kJ mol^{-1}
$U = -758.7$ kJ mol^{-1}
According to Born cycle:
$\Delta H_f^\circ = + \Delta_{sub}H^\circ + \text{IE} + \frac{1}{2}\Delta_{diss}H^\circ + \Delta_{eg}H^\circ + U$
Substituting :
$\Delta H_f^\circ = + 108.5 + 495.8 + \frac{1}{2} \times 243.0 + (-348.8) + (-758.7)$
$\Delta H_f^\circ = -381.7$ kJ mol^{-1}
Hence the heat of formation of NaCl is –381.7 kJ mol^{-1}

4. Explain the structure of $PC1_5$ molecule, using Sugden's concept.

Ans. Electronic Configuration of P is: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p_x^1\ 3p_y^1\ 3p_z^1$
It has three valence electrons, which combines with three chlorine atoms and thus achieve an octet.
The remaining two atoms of chlorine are attached to central Phosphorus atom by singlet linkage.



5. On the basis of VSEPR theory, predict the bond angles in the following molecules: $BeCl_2$, PH_3, OF_2, BF_3, SiH_4,

Ans. $BeCl_2$ — 180°
PH_3 — 120°
OF_2 — 180°
BF_3 — 120°
SiH_4 — 109°.28′

6. Write a short note on dipole moment, its unit and its significance.

Ans.
- The polarity in a covalent bond can be measured in terms of a physical quantity called dipole moment.
  - $\mu = q \times r$
  - Debye is the unit to measure dipole moment.
  - It is represented by D, and
  - $1D = 1 \times 10^{-18}$ e s u cm
  - Dipole moment indicates:
    - the polarity of bonds

  Information regarding structure of molecule.

7. Explain the formation of CH, molecule?

Ans. **(a)** Electronic configuration of C in the excited state is $1s^2\ 2s^1\ 2p_x^1\ 2p_y^1\ 2p_z^1$

(b) The methane molecule undergoes sp^3 hybridisation.

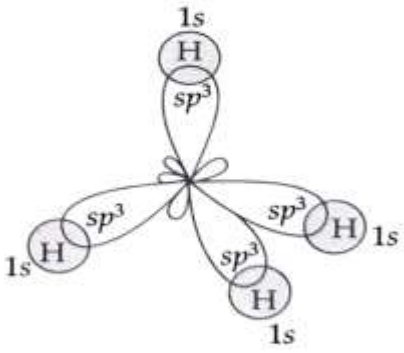
(c) The four hybrid orbitals are directed towards the four corners of a regular tetrahedron at 109° 28′ with C atom at the centre.

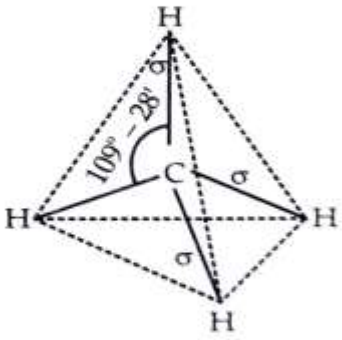
(d) Each hybrid orbital contains an unpaired electron and overlaps with the 1s orbital of hydrogen atom.

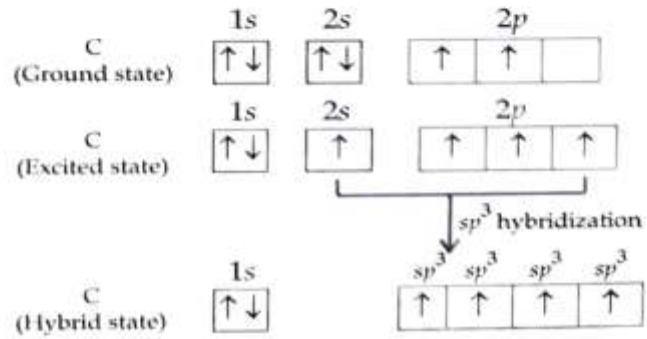
(e) Thus, four C-H σ bonds are formed.

(f) The resulting methane molecule is tetrahedral in shape.

(g) Each H-C-H angle is 109° 28′.







8. Write the molecular orbital configuration, bond order and predict the magnetic behaviour of the following species: O_2, O_2^+, O_2^-, O_2^{2-}

Ans. **(a)** O_2 : KK $(\sigma 2s)^2$ $(\sigma^*2s)^2$ $(\sigma 2p_z)^2$ $(\pi 2p_x)^2$ $(\pi 2p_y)^2$ $(\pi^* 2p_x)^1$ $(\pi^*2p_y)^1$

(b) O_2^+ : KK $(\sigma 2s)^2$ $(\sigma^*2s)^2$ $(\sigma 2p_z)^2$ $(\pi 2p_x)^2$ $(\pi 2p_y)^2$ $(\pi^* 2p_x)^1$

(c) O_2^- : KK $(\sigma 2s)^2$ $(\sigma^*2s)^2$ $(\sigma 2p_z)^2$ $(\pi 2p_x)^2$ $(\pi 2p_y)^2$ $(\pi^* 2p_x)^2$ $(\pi^*2p_y)^1$

(d) O_2^{2-} : KK $(\sigma 2s)^2$ $(\sigma^*2s)^2$ $(\sigma 2p_z)^2$ $(\pi 2p_x)^2$ $(\pi 2p_y)^2$ $(\pi^* 2p_x)^2$ $(\pi^*2p_y)^2$

KK stands for $(\sigma 1s)2$ $(\sigma^*1s)^2$

Bond order:

(a) Bond order $= \frac{N_b - N_a}{2} = \frac{8-4}{2} = 2$

(b) Bond order $= \frac{N_b - N_a}{2} = \frac{8-3}{2} = 2\frac{1}{2}$

(c) Bond order $= \frac{N_b - N_a}{2} = \frac{8-5}{2} = 1\frac{1}{2}$

(d) Bond order $= \frac{N_b - N_a}{2} = \frac{8-6}{2} = 1$

Magnetic behaviour :

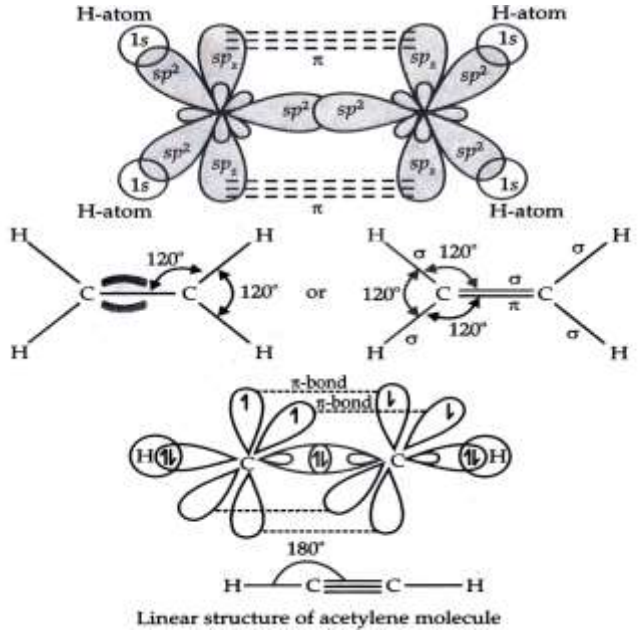
(a) Paramagnetic.

(b) Paramagnetic.

(c) Paramagnetic.

(d) Diamagnetic.

9. Draw the structure of ethylene and acetylene molecule, showing: (a) overlapping of orbitals (b) o and n bond and bond angles



Linear structure of acetylene molecule