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CHEMICAL BONDING AND MOLECULAR STRUCTURE

Now the five orbitals (i.e., one s, three p and one d orbitals) are available for hybridisation to yield a set of five sp^3d hybrid orbitals which are directed towards the five corners of a trigonal bipyramidal as depicted in the Fig. 4.17.

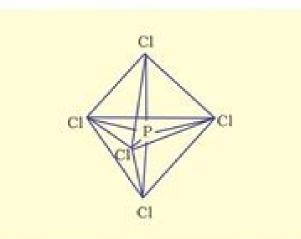


Fig. 4.17 Trigonal bipyramidal geometry of PCl₃ molecule

It should be noted that all the bond angles in trigonal bipyramidal geometry are not equivalent. In PCl_s the five sp³d orbitals of phosphorus overlap with the singly occupied p orbitals of chlorine atoms to form five P-Cl sigma bonds. Three P-Cl bond lie in one plane and make an angle of 120° with each other; these bonds are termed as equatorial bonds. The remaining two P-Cl bonds-one lying above and the other lying below the equatorial plane, make an angle of 90° with the plane. These bonds are called axial bonds. As the axial bond pairs suffer more repulsive interaction from the equatorial bond pairs, therefore axial bonds have been found to be slightly longer and hence slightly weaker than the equatorial bonds; which makes PCl, molecule more

(ii) Formation of SF₆ (sp³d² hybridisation): In SF₆ the central sulphur atom has the ground state outer electronic configuration 3s²3p⁴. In the exited state the available six orbitals i.e., one s, three p and two d are singly occupied by electrons. These orbitals hybridise to form six new sp³d² hybrid orbitals, which are projected towards the six corners of a regular octahedron in SF₆. These six sp³d² hybrid orbitals overlap with singly occupied orbitals of fluorine atoms to form six S-F sigma bonds. Thus SF₆ molecule has a regular octahedral geometry as shown in Fig. 4.18.

125

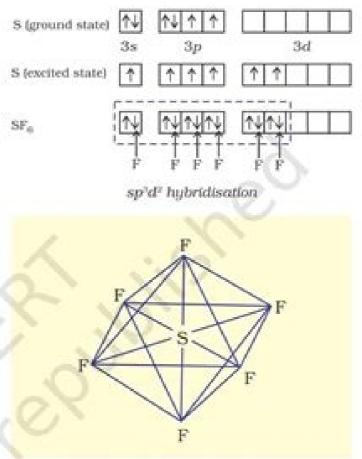


Fig. 4.18 Octahedral geometry of SF_e molecule

4.7 MOLECULAR ORBITAL THEORY

Molecular orbital (MO) theory was developed by F. Hund and R.S. Mulliken in 1932. The salient features of this theory are:

- i) The electrons in a molecule are present in the various molecular orbitals as the electrons of atoms are present in the various atomic orbitals.
- (ii) The atomic orbitals of comparable energies and proper symmetry combine to form molecular orbitals.
- (iii) While an electron in an atomic orbital is influenced by one nucleus, in a molecular orbital it is influenced by two or more nuclei depending upon the number of atoms in the molecule. Thus,

2020-21

114 CHEMISTRY

Table 4.6 Geometry of Molecules in which the Central Atom has No Lone Pair of Electrons

Number of electron pairs	Arrangement of electron pairs	Molecular geometry	Examples
	180°		
2	::	В-А-В	BeCl ₂ , HgCl ₂
	Linear	Linear	
	ж	B	
3	A 120°	A	BF_3
	· -	ВВ	
	Trigonal planar	Trigonal planar	
		В	
	109.5°		CH ₄ ,NH ₄
4	: (Av):	В	
	Tetrahedral	B Tetrahedral	
		В	
	VA 0		
5	: (190°):	В	PCl ₅
	120	RET /	
	Factor 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	B	1
	Frigonal bipyramidal	Trigonal bipyramida B	41
		В	
6	90 - 13 - 13	B	CP.
	: ()	В	SF ₆
	Ä	B	
	Octahedral	Octahedral	

2020-21



216 CHEMISTRY

7.10.3 Lewis Acids and Bases

G.N. Lewis in 1923 defined an acid as a species which accepts electron pair and base which donates an electron pair. As far as bases are concerned, there is not much difference between Brönsted-Lowry and Lewis concepts, as the base provides a lone pair in both the cases. However, in Lewis concept many acids do not have proton. A typical example is reaction of electron deficient species BF₃ with NH₃.

BF₃ does not have a proton but still acts as an acid and reacts with NH₃ by accepting its lone pair of electrons. The reaction can be represented by,

$$BF_3 + :NH_3 \rightarrow BF_3 :NH_3$$

Electron deficient species like AlCl₃, Co^{3*}, Mg^{3*}, etc. can act as Lewis acids while species like H₂O, NH₃, OH etc. which can donate a pair of electrons, can act as Lewis bases.

Problem 7.15

Classify the following species into Lewis acids and Lewis bases and show how these act as such:

Solution

(a) Hydroxyl ion is a Lewis base as it can donate an electron lone pair (:OH).

- (b) Flouride ion acts as a Lewis base as it can donate any one of its four electron lone pairs.
- (c) A proton is a Lewis acid as it can accept a lone pair of electrons from bases like hydroxyl ion and fluoride
- (d) BCl₃ acts as a Lewis acid as it can accept a lone pair of electrons from species like ammonia or amine molecules.

7.11 IONIZATION OF ACIDS AND BASES

Arrhenius concept of acids and bases becomes useful in case of ionization of acids and bases as mostly ionizations in chemical and biological systems occur in aqueous medium. Strong acids like perchloric acid (HClO₄).

hydrochloric acid (HCl), hydrobromic acid (HBr), hyrdoiodic acid (HI), nitric acid (HNO.) and sulphuric acid (H,SO,) are termed strong because they are almost completely dissociated into their constituent ions in an aqueous medium, thereby acting as proton (H*) donors. Similarly, strong bases like lithium hydroxide (LiOH), sodium hydroxide (NaOH), potassium hydroxide (KOH), caesium hydroxide (CsOH) and barium hydroxide Ba(OH), are almost completely dissociated into ions in an aqueous medium giving hydroxyl ions, OH. According to Arrhenius concept they are strong acids and bases as they are able to completely dissociate and produce H₂O and OH ions respectively in the medium. Alternatively, the strength of an acid or base may also be gauged in terms of Bronsted-Lowry concept of acids and bases, wherein a strong acid means a good proton donor and a strong base implies a good proton acceptor. Consider, the acid-base dissociation equilibrium of a weak acid HA,

$$HA(aq) + H_2O(l) \rightleftharpoons H_3O^*(aq) + A^*(aq)$$

 $eonjugate$
 $acid$ base $acid$ base

In section 7.10.2 we saw that acid (or base) dissociation equilibrium is dynamic involving a transfer of proton in forward and reverse directions. Now, the question arises that if the equilibrium is dynamic then with passage of time which direction is favoured? What is the driving force behind it? In order to answer these questions we shall deal into the issue of comparing the strengths of the two acids (or bases) involved in the dissociation equilibrium. Consider the two acids HA and H₃O* present in the above mentioned acid-dissociation equilibrium. We have to see which amongst them is a stronger proton donor. Whichever exceeds in its tendency of donating a proton over the other shall be termed as the stronger acid and the equilibrium will shift in the direction of weaker acid. Say, if HA is a stronger acid than H₂O*, then HA will donate protons and not H,O*, and the solution will mainly contain A and H,O ions. The equilibrium moves in the direction of formation of weaker acid and weaker base

2020-21

371

ORGANIC CHEMISTRY - SOME BASIC PRINCIPLES AND TECHNIQUES

(b) CH₃COCH₃ + CN → (CH₃)₂ C(CN)(OH)

(c) C_aH_a + CH₃ CO → C_aH₅COCH₃
 12.14 Classify the following reactions in one of the reaction type studied in this unit.

(a) $CH_3CH_2Br + HS^- \rightarrow CH_3CH_2SH + Br^-$

(b) $(CH_3)_2 C = CH_2 + HCl \rightarrow (CH_3)_2 ClC - CH_3$

(c) $CH_3CH_2Br + HO^- \rightarrow CH_2 = CH_2 + H_2O + Br^-$

(d) $(CH_3)_3 C - CH_2OH + HBr \rightarrow (CH_3)_2 CBrCH_2CH_2CH_3 + H_2O$

2.15 What is the relationship between the members of following pairs of structures? Are they structural or geometrical isomers or resonance contributors?

12.16 For the following bond cleavages, use curved-arrows to show the electron flow and classify each as homolysis or heterolysis. Identify reactive intermediate produced as free radical, carbocation and carbanion.

(a) CH,O - OCH, -+ CH,O + OCH,

(b)
$$\geq = 0 + OH \longrightarrow \geq = 0 + H_0O$$

(c)
$$\downarrow_{Br} \rightarrow \downarrow_{E} + Br^{T}$$

(d) $\downarrow_{Br} + E^{+} \rightarrow \downarrow_{E}$

different solubilities in a solvent S.

12.17 Explain the terms Inductive and Electromeric effects. Which electron displacement effect explains the following correct orders of acidity of the carboxylic acids?
(a) Cl_CCOOH > Cl_CHCOOH > ClCH_COOH

(b) CH₂CH₂COOH > (CH₂)₂CHCOOH > (CH₂)₃C.COOH
2.18 Give a brief description of the principles of the following techniques taking an example in each case.

(a) Crystallisation (b) Distillation (c) Chromatography

19 Describe the method, which can be used to separate two compounds with

12.20 What is the difference between distillation, distillation under reduced pressure and steam distillation?

2019-20

So, they can purchase through online sites. From Alcohols: - Dehydration > Chemical Properties:- (Brown colour) (Colourless) Addition Reaction:- Alkene show electrophilic addition reaction . Noted :- the boiling points of the branched chain Alkanes are less than the straight chain isomers. 8. Aromatic hydrocarbons are non- polar molecules and are usually colourless liquids or solids with a characteristic aroma. C1—C4 = gases, C5—C17 = colourless odourless liquid and > C17 = Solid. (3) Boiling point :- Low boiling point due to non polar in nature The molecules are held together only by weak Van der Waalls' forces. Download Atomic Structure Notes - B.Sc Chemistry Year 1 can candidates can refer to this article. However, due to resonance the electron ensity on o- and p- positions is greater than that at the m-position. n-penatne (boling point = 309 k iso- pentane boling point = 280.5 k regular variation with ven number of carbon atoms having higher melting point a 202 CO2 2H2O lkanes having immediately next lower and immediately next higher odd number of carbon atoms. CLASSIFICATION OF HYDROCARBONS: HYDROCARBON Cycloalkanes Cycloalkenes Cycloalkynes C-C bond > Chemically unreactive > Show chain, position and optical isomerism. Addition of Hydrogen:- 3. This is often referred to as Hückel Rule Preparation of Benzene (i) Cyclic polymerisation of ethyne (ii) Decarboxylation of phenol: Phenol is reduced to benzene by passing its vapours over heated zinc dust Physical properties: 1. The orbital overlapping picture benzene - All the six carbon atoms in benzene are sp2 hybridized and these hybrid orbitals form sigma bonds. The main constituents of the natural gas are methane, ethane, propane and butane. So Alkenes are also known as Olefins. • General molecular formula CnH2n • C-C bond hybridization 1.34 AO • sp2 hybridization • When we treated Alkene with chlorine, oily products are obtained. The unhybridised p orbital of carbon atoms are close enough to form a π bond by lateral overlap. Features of Halogenations:- (i) The reactivity of Halogens:- F2 > Cl2 > Br2 > I2. Addition of water (Hydration) :- Acid catalyzed addition of water of Halogenstion of water (Hydration) is described by lateral overlap. Features of Halogenstions:- (i) The reactivity of Halogensian of water of Halogensian of Halo alkaline H2O2 give alcohols. Noted:- peroxide effect is applicable only to HBr and not to HF, HCl and HI. PETRA - ROCK, OLEUM - OIL. These are the compounds usually called hydrocarbons. The oil in the petroleum field is covered with a gaseous mixture known as natural gas. (i) Planarity (ii) Complete delocalisation of the π electrons in the ring (iii) Presence of (4n + 2) π electrons in the ring where n is an integer (n = 0, 1, 2, . This reaction is used as a test for the presence of double bond in a molecule. > The important fuels like Petrol, kerosene, coal gas, CNG, LPG etc. Polymerisation- a. 3.Oxymercuration-demercuration: 4.Oxidation with potassium permanganate: > This reaction is also called Hydroxylation > Cis product I.e. cis-diol is obtained. 1. Meta directing group and deactivating:-NO2, -CN, -COOH, -C that when HBr is added to an unsymmetrical double bond in the presence of organic peroxide, the reaction take places opposite to the Markovnikov rule. Isomerisation :- CONFORMATIONAL ISOMERISM: The different molecular arrangements arising as a result of rotation around carbon carbon single bonds are called conformational isomers or rotational isomers and the phenomenon is called conformational isomerism. Ortho and para directing groups and deactivating: Halogens because of their strong - I effect, overall electron density on benzene ring decreases. They can download these links at any time. Download Atomic Structure Notes Download links Atomic StructureDownloadChemical Bonding and Molecular Structure PDFDownload Atomic Structure PDF, Click on the below link to download the Self Learning Material (SLM): Atomic StructureDownload LinksDownloadD electrons in benzene makes it more stable. (Greek olefiant meaning oil forming). Chemical properties Arenes are characterised by electrophile (b) Formation of carbocation intermediate (c) Removal of proton from the carbocation intermediate benzene ontreatment with excess of chlorine in the presence of anhydrous AlCl3 in dark yields hexachlorobenzene (C6Cl6) Addition reactions of benzene- 1. And, the subject important topics were also above for the scholars. Atomic StructureBohr's TheoryDual Behaviour of Radiation and MatterQuantum Mechanical ApproachHydrogen AtomElectronic Configuration of Multi-electronic BondCovalent BondC IsomersStereochemistry-III: Conformational IsomerismStructure-Reactivity RelationshipsReactions and Reactive IntermediatesHydrocarbonsAlkanesAlkenes - IAlkenes - IIAlkynesAromaticityDownload Atomic Structure NotesDownload Inks of the subject important topics were also mentioned below in a table for the candidates to download. And, the download links were mentioned below for the candidates. • General molecular formula CnH2n-2 • sp hybridization • Shows chain, positional and functional isomerism • Preparation:- From vicinal dihalides: - dehalogenation By the action of water on calcium carbide:- > Chemical Properties:- Addition Reaction:- Alkyne show electrophilic addition reaction 1. The delocalised π electron cloud is attracted more strongly by the nuclei of the carbon atoms. It has bright pink colour. From carboxylic acids: Decarboxylation Physical Properties:- (1) Nature: Non-Polar due to covalent nature of C—C bond and C—H bond. 4. This is also known as Baeyer test. It oxidizes alkenes to glycols which is colourless. This is possible by using a Lindlar's catalysts or sodium in liquid NH3 at 200k temp.. 2.Addition of hydrogen halides:- 4.Addition of hydrogen halides:- 4.Ad

AND TOXICITY-Benzene and polynuclear hydrocarbons containing more than two benzene rings fused together are toxic and said to possess cancer producing (carcinogenic) property. Noted:- Fluorination of alkane takes place explosively resulting even in the rupture of C—C bond in higher alkanes. Noted:- It may be again noted that the catalytic reduction of alkynes in the presence of Lindlar's catalyst gives cis-alkenes while in the presence of sodium in liquid NH3 (Birch reduction) gives trans-alkenes. Subject Edition, Year, Available in details also were mentioned above. (ii) The rate of replacement of Hydrogens of alkanes is: -3° > 2° > 1° Mechanism: -halogenations reaction take place by free radical mechanism. The reaction proceeds in the following steps: Initiation (i) Chain initiation step:-(ii) Chain Propagation step :-(iii) Chain Termination step:-Nitration:- • The reaction takes places by free radicals mechanism at high temp (450oC). Usually, Aliphatic Hydrocarbons are three types. Book TitleAtomic Structure, Bonding, General Organic Chemistry, and Aliphatic HydrocarbonsCourseB.Sc (Bachelor of Science) ChemistryYearYear 1Similar BooksIGNOU ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY, AND ALIPHATIC HYDROCARBONSAtomic Structure, General Organic Chemistry, Bonding, and Aliphatic HydrocarbonsBonding, General Organic Chemistry, Atomic Structure, And Aliphatic HydrocarbonsAtomic Structure, Bonding, General Organic Chemistry, And Aliphatic Hydrocarbons, Atomic Structure Important TopicsAtomic Structure Chemical Bonding and Molecular StructureFundamentals of Organic ChemistryHydrocarbonsAvailable inPDF, eBook FormatEdition2021LanguageEnglishOnly these candidates have to refer to this Download Atomic Structure, Bonding, General Organic Chemistry, and Aliphatic Hydrocarbons Subject Important TopicsThe below mentioned are the important topics of the subject. Alkynes • Unsaturated hydrocarbon which have triple bond. Two extreme conformations are known as petroleum. Sources: Petroleum and natural gas are the major sources of aliphatic hydrocarbon while coal is an important source of aromatic hydrocarbons. Addition reaction of HBr to unsymmetrical alkenes takes place according to Markovnikov Rule Markovnikov rule: negative part of the addendum (adding molecule) gets attached to that carbon atom which possesses lesser number of hydrocarbon, saturated hydrocarbon, s and unsaturated hydrocarbon, define saturated hydrocarbons, class 11 notes, class 11 notes, lass 11 notes, hydrocarbons class 11 notes, hydrocarbons, note chemistry notes, hydrocarbons, note chemistry notes, hydrocarbons, class 11 notes, hydrocarbons, note chemistry notes, hydrocarbons, hydrocar notes, class 11 chemistry notes chapter 13, hydrocarbons chapter class 11 notes > Hydrocarbons are composed of Carbon and hydrogen. Aromaticity:- The compounds that follow the following features are to be considered aromatic. are all hydrocarbons or their mixture. From Dihaloalkane s: - dehalogenation 4. Thermal decomposition or Pyrolysis or cracking or Fragmentation: - when higher alkanes are heated at high temp (about 700-800k) in the presence of alumina or silica catalysts, the alkanes break down to lower alkanes and alkenes. (2) Solubility: - Like dissolve line polar solvent. 3. CH3-CH2-CH3 CH3-CH-CH2 + CH3-CH3 + CH4 Action of steam: catalyst: nickel, alumina Al2O3 1000 oC CH4 + H2O(Steam) CO + 3H2 This reaction is used for the industrial preparation of hydrogen from natural gas. And, also we have mentioned the Laboratory Manual below. Atomic StructureChemical Bonding and Molecular StructureFundamentals of Organic ChemistryHydrocarbonsLaboratory ManualWe were also mentioning the Laboratory Manual for the students on the same page itself with the Experiments as well which makes it easier for the candidates to refer to the lab manual also.UNIT 1Titrimetry: An IntroductionEXPERIMENT 1Determination of Sodium Carbonate and Sodium Hydrogen Carbonate Present in a Mixture EXPERIMENT 2Estimation of Oxalic Acid by Redox Titration EXPERIMENT 3Estimation of Iron(II) Ions by Chromatometry using Internal Indicator EXPERIMENT 5Estimation of Copper(II) Ions IodometricallyEXPERIMENT 6Detection of Extra Elements (N, S, X) in the Organic CompoundsEXPERIMENT 7Separation & Identification of the Sugars Present in the given Mixture by Paper ChromatographyUnit Wise TitlesList of the Unit Wise Titles of the Unit Wise Titles of the Atomic Structure, Bonding, General Organic Chemistry, and Aliphatic Hydrocarbons Subject. And, also we have mentioned the Subject's Important Topic, Similar Books, And, Laboratory Manual as well. Structure of Benzene- Kekulé structure Resonance and stability of benzene-Benzene is a hybrid of various resonating structures. • Show chain, positional and geometrical isomerism > Structure of double bond: > Preparation:- 1. From Alkynes on partial reduction with Partially deactivated palladised charcoal known as Lindlar's catalyst give alkynes. Hydrocarbons and Aliphatic Hydrocarbons based on the Chains of C atoms. (Indira Gandhi National Open University) IGNOU was providing this Atomic Structure, Bonding, General Organic Chemistry, and Aliphatic Hydrocarbons Notes. Students can also check B.Sc Atomic Structure Study Material which has been provided here on this page, with pdf links also for download purposes. B.Sc Chemistry Download Atomic Structure Notes This Atomic Structure, Bonding, General Organic Chemistry, and Aliphatic Hydrocarbons subject tells about the organic compounds which were composed of two elements: Hydrogen and Carbon. • At high temp C—C bond is also broken so that mixture of nitroalkanes is obtained.

Ozonolysis - give carbonyls compounds Noted:-Bromine water test and Baeyer's test are used to detect the presence of double bond. Important Links So it is carried out by heating alkane in the presence of some oxidizing agent like iodic acid (HIO3) or nitric acid (H reaction. They burn with sooty flame. This method is also called dehydrogenation or hydroforming Similarly, heptane gives toluene, n-Octane give o-xylene and 2, methyl heptane gives toluene, n-Octane give o-xylene and 2, methyl heptane gives toluene, n-Octane gives tolu download these links. The prices of the book were also mentioned. So, we have mentioned the complete details about Download Atomic Structure Notes. These are eclipsed conformation and staggered conformation. So, we can clear all those doubts. 2. Acidity of Alkynes are acidic in nature Alkanes, alkenes and alkynes follow the following trend in their acidic behaviour: AROMATIC HYDROCARBON Aromatic compounds containing a benzene ring are known as benzeneids. Numerous possible arrangements of ethane are possible. Linear polymerisation: of ethyne gives polyacetylene or polyethyne which is a high molecular weight polyene containing repeating units of (CH = CH - CH = CH) and can be represented as —(CH = CH - CH = CH)n — b. 2. From Haloalkanes: - dehydrohalogenation (E2 or 1,2-elimination or Bita-elimination) > predominant formation of a substituted alkene is formed according to Saytzeff's rule 3. Ortho and para directing groups and activating: -OH, -NH2, -NHR, -NHCOCH3, -CCH3, -CCH3 preparing even number of carbon atoms Stepping up reaction an alkane containing Frankland reaction 4. Addition of Hydrogen:- Hydrogenation. The six π electrons are thus delocalised and can move freely about the six carbon nuclei. This is due to the fact that branching of the chain makes the molecule more compact and thereby decreases. SAWHORSE REPRESENTATION NEWMAN PROJECTION Alkenes • Unsaturated hydrocarbon which have double bond. Aromatic hydrocarbons are immiscible with organic solvents. C— C bond enroy = 83 kj/mole and C—H bond energy = 99 kj/mole. Since we known that the magnitude of Van der Waalls' forces is directly proportional to the molecular size. Therefore, the boiling point increases with increase the molecular size i.e. with increase in number of carbon atoms. So, the candidates can refer to these similar books at any time they want. IGNOU ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY. AND ALIPHATIC HYDROCARBONSAtomic Structure, General Organic Chemistry, Atomic Structure, Bonding, General Organic Chemistry, Bonding, StructureBuy through Amazon.inIGNOU ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY, AND ALIPHATIC HydrocarbonsAtomic Structure, General Organic Chemistry, & Aliphatic HydrocarbonsAtomic Structure, Bonding, General Organic Chemistry, & Aliphatic HydrocarbonsAtomic Structure, Bonding, General Organic Chemistry, and Aliphatic HydrocarbonsBonding, General Organic Chem Chemistry, Atomic Structure, And Aliphatic Hydrocarbons Bonding, General Organic Chemistry, and aliphatic Hydrocarbons Notes. Addition of HF, HCl and HI takes place according to Markovnikov's rule even in the presence of peroxide.

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