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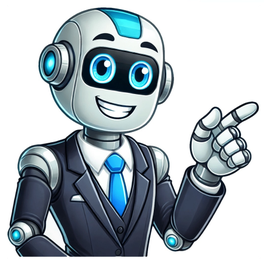

Welcome to the ChemistryLibrary. This Living Library is a principal hub of the LibreTexts project, which is a multi-institutional collaborative venture to develop the next generation of open-access texts to improve postsecondary education at all levels of higher learning. The LibreTexts approach is highly collaborative where an Open Access textbook environment is under constant revision by students, faculty, and outside experts to supplant conventional paper-based books. Campus BookshelvesBookshelvesLearning Objects Home is shared under a not declared license and was authored, remixed, and/or curated by LibreTexts. Chemical bonds are the bonds between atoms that are formed during chemical reactions. These bonds allow substances containing two or more atoms to be formed. They are formed by electrostatic forces of attraction between the oppositely charged nuclei and electrons, or by a dipole attraction. Chemical bonds occur in the world all around us. Even the most basic things from oxygen to table salt require chemical bonds to form. There are many different types of chemical bonds, including covalent bonds, ionic bonds, metallic bonds and hydrogen bonds. Atoms form bonds in order to attain a stable electronic configuration. Oxygen (O_2) is an example of a covalent bond, where atoms share their electrons. In contrast, table salt or sodium chloride ($NaCl$) is an example of an ionic bond, where an electron from an atom is transferred to another causing the two atoms to be positively and negatively charged, thus attracting each other. Chemical bonding is the study of bonds that exist between the atoms or molecules. This chapter explains why only certain atoms combine with each other and make a new product and their arrangement in a definite shape. There are various theories such as VSEPR, valence bond theory, and the molecular orbital theory that will explain all the phenomena in detail. Bonding is not just an instance but it is nature's way to take every atom or molecule to its most stable state.Notes For Chemical Bonding And Molecular StructureImportant Topics:How to Prepare for Chemical bonding?Prescribed Books Chemical Bonding and Molecular Structure - Notes, Topics, Books, FAQs In our body itself, all the macromolecules like DNA, RNA, Proteins, etc are held together with the help of this chemical bond. All the structures are held together with the help of this chemical bond, either the bond is stronger or weaker. Based on the strength of the bonds, the stability of the structure is determined. The melting and boiling point, etc are the important properties that are determined by the strength of the chemical bond. This chapter is usually liked by every student as it is very easy and it holds enough distribution of marks in Board exams and other competitive exams like JEE and NEET.Notes For Chemical Bonding And Molecular StructureIn this section, you will study the important topics of the chapter, overview, formulae, and some important tips and guidelines for the preparation of the chapter at the best.Important Topics:There are the following important topics that are covered in this chapter:Ionic bonding: Ionic bonds or Electrovalent bonds are formed from the electrostatic attraction between oppositely charged ions in a chemical compound.Fazans rule: Fajans Rule helps to predict whether a chemical bond is ionic or covalent. It states that the size and charge of cations and anions determine the type of bond forms. Lewis Electron Dot Structures: Lewis Electron Dot Structures is the important topic of this chapter in this we study how the electrons are arranged in the elements to bond with another element.Limitations Of The Octet Rule: Limitations Of The Octet Rule is also an important topic. The octet rule has various limitations it does not apply to all states, it does not count the number of electrons, and it does not apply to elements with fewer than eight electrons.Formal charge and Lewis dot structures: A hypothetical charge assumed to be an atom in a molecule is called a formal charge, assuming that electrons are shared equally between atoms. It is very helpful in predicting a molecule's reactivity and structure.Bond Parameters - Bond Order, Angle, Length, And Energy: Bond Parameters - Bond Order, Angle, Length, And Energy is the most important topic for knowing the stability of the bond or the compounds form after bonding.Valence Shell Electron Pair Repulsion (VSEPR) theory: Vsepr Theory is based on the repulsion between the pairs of valence electrons. The electrons repel each other in order to minimize the repulsion.Valence Bond Theory (VBT): The overlapping between two incompletely filled atomic orbitals leads to the formation of a bond between two atoms is called Valence Bond Theory.Hybridization and its types: The process of combining two atomic orbitals to create a new type of hybridized orbitals is called Hybridisation is also an important topic.Molecular Orbital Theory (MOT): Molecular Orbital Theory explains how molecules form and behave by describing the distribution of electrons in a molecule. It has a different principle which tells molecular orbitals are equal to the atomic orbitals.Also read, Overview of Chemical Bonding:All atoms in this universe seek to achieve their stable electronic configuration in the Noble gas configuration. Atoms except Hydrogen achieve this stable noble gas configuration by following the octet rule in the following ways:(i) Ionic bond: In this type of bond, metals, and non-metals take part in the bond formation by the complete exchange of electrons as depicted in the picture below:(ii) Fazan's Rule: This rule states that in every ionic bond, there is always some percentage of covalent character. This covalent character depends upon the size of the anion and cation, a charge of the anion and cation. As the charge on the cation is larger and its size is smaller its polarising power increases and thus the covalent character increases. Similarly for an anion, if its charge is higher and its size is also larger then its polarisability increases and thus the covalent character increases.(iii) Covalent bond: This type of bond formation takes place by the sharing of electrons between the non-metals. The picture given below shows its representation.In this chapter, you will learn about the Lewis dot structures. Lewis dot structure is the simple representation of the molecules formed by the covalent bonds. However, in this concept, the geometry of the molecules needs to be determined, which is one of the major drawbacks of this concept. So to overcome these drawbacks, several advanced theories have been given by scientists and they are VSEPR, VBT, and MOT.(iv) Kossel Lewis Approach: This is the simplest model for explaining the structures of the chemical bond. This approach considers the central atom as a sphere and electrons as point charges around it. Now, these point charges electrons are shared between atoms or completely exchanged between atoms and form the covalent and ionic bond respectively. After the formation of these bonds, all the atoms engaged in bonding achieve the stable noble gas configuration. (v) VSEPR Theory:In VSEPR theory, it was said that the shapes of the molecules are determined by the combination of a lone pair of electrons and bond pair electrons.These electrons repel each other. In order to minimize the repulsion, these electrons arrange themselves at the maximum distance and hence form the geometry.Some common geometries of the molecules are tetrahedral, square planar, octahedral, etc.NEET Highest Scoring Chapters & TopicsThis ebook serves as a valuable study guide for NEET exams, specifically designed to assist students in light of recent changes and the removal of certain topics from the NEET exam. Download EBookMolecule TypeMolecule ShapeExamplesAB2LinearCO2AB3Trigonal PlanarBF3AB4Tetrahedral CH4AB5Trigonal bi-pyramidalPCl5AB6OctahedralSF6(vi) Valence Bond Theory:The bond formation takes place only by the valence orbitals containing unpaired electrons and spinning in opposite directions.Bond formation takes place by partial overlapping of orbitals. So, according to this theory, various kinds of overlapping occurs during bond formation like s-s overlapping, s-p overlapping, p-p overlapping, and pi bond (lateral overlapping of p orbital).(vii) Hybridization:This concept says that during the time of bond formation, the first intermixing of orbitals of comparable energies occurs to produce the new orbitals, also known as hybrid orbitals, and then bond formation occurs. The hybridization concept eliminates all the drawbacks that were not solved by the earlier theories.The number of hybrid orbitals produced is equal to the number of atomic orbitals.The hybrid orbitals are identical in shape, size, energy, etc.The hybrid orbitals always form a sigma bond.Molecule shapeHybridizationLinearspTrigonal Planarsp2Tetrahedralsp3Trigonal Bi-pyramidalsp3dOctahedralsp3d2Pentagonal Bi-pyramidalsp3d3For example, BeF_2 This bond is not explained by VSEPR and VBT, thus hybridization explains its bond formation and structure. This is explained below: Finally, at the end of this chapter, you will learn about a new theory i.e. Molecular Orbital Theory. This theory is applicable to only diatomic molecules like O_2, N_2, F_2, etc. This theory explains several things like electron distribution in bonding and antibonding molecular orbitals, bond order, and paramagnetic or diamagnetic nature of molecules.How to Prepare for Chemical bonding?Although this chapter is a part of physical chemistry it is a completely theory-based chapter. For preparing this chapter, a formula or numerical practice is not required. To solve the questions of this chapter, first, you must have a complete understanding of Atomic structure and classification of elements and periodicity in properties chapters. For a good hold in this chapter, you must give a mock test after completing the theory and you need to go through class 11th NCERT book thoroughly. Prescribed BooksFor chemical bonding and molecular structure, first, you need to finish the theory thoroughly from the NCERT book and then solve the examples and questions given in the book. Apart from this, if you want to prepare for the advanced level of competitive exams like JEE and NEET, you must read the book - O.P Tandon or P. Bahadur. Meanwhile, in the preparation, you must continuously take the mock tests for internal assessment. Share copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. ShareAlike If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. No additional restrictions You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. President Bob Henderson is President of GfG Instrumentation, Inc. in Ann Arbor, Michigan.Robert has been a member of the American Industrial Hygiene Page 2By clicking sign up, you agree to receive emails from Safeopedia and agree to our Terms of Use & Privacy Policy. Chemistry is a subject requiring deep, analytical and critical thinking. It has three categories namely Physical, Organic and Inorganic chemistry. Class 11 Chemistry Chapter 4 Chemical Bonding and Molecular Structure is the study of the structure of monoatomic and diatomic molecules and associated chemical bonding with them. The important concepts included in the chapter are:Kssel-Lewis Approach To Chemical BondingIonic Or Electrovalent BondBond ParametersThe Valence Shell Electron Pair Repulsion (VSEPR) TheoryValence Bond TheoryHybridisationMolecular Orbital TheoryBonding In Some Homonuclear Diatomic MoleculesHydrogen Bonding.Extramarks has been providing great online study resources for Class 11 and Class 12 students. Along with NCERT solutions and chapter-specific study notes, we have created the Important Questions Class 11 Chemistry Chapter 4 booklet that will help students to revise all the topics from the chapter while solving these questions. The questions are taken by our Chemistry expert teachers from various sources including NCERT textbooks, NCERT Exemplar books, past years question papers, CBSE sample papers, etc. The resources provided by Extramarks have been updated as per the latest CBSE syllabus. That keeps students oriented with the latest curriculum. You can get all the NCERT-related material and the Important Questions Class 11 Chemistry Chapter 4 on our official website.Get Access to CBSE Class 11 Chemistry Important Questions 2022-23 with SolutionsSign Up and get complete access to CBSE Class 11 Chemistry Important Questions for other chapters too: Class 11 Chemistry Chapter 4 Important Questions with AnswersBelow are a few of the important questions and their solutions included in our Class 11 Chemistry Chapter 4 Important Questions:Question 1. Isostructural species are those that have the same shape and hybridisation.Among the given species, clarify the isostructural pairs.(i) [NF_3 and BF_3](ii) [BF_4 and NH_4^+](iii) [BCl_3 and $BrCl_3$](iv) [NH_3 and NO_3]Answer 1. Option (ii) is the answer.Question 2. Polarity in a molecule and hence the dipole moment depends primarily onthe constituent atoms electronegativity and the molecules shape. Which ofthe following has the highest dipole moment?(i) CO_2(ii) HI(iii) H_2O(iv) SO_2Answer 2. Option (iii) is the answer.Question 3. The types of hybrid orbitals of nitrogen in NO_2^+, NO_3 and NH_4^+respectively expected to be(i) sp, sp3 and sp2(ii) sp, sp2 and sp3(iii) sp2, sp and sp3(iv) sp2, sp3 and spAnswer 3. Option (ii) is the answer.Question 4. Hydrogen bonds are formed in many compounds, e.g., H_2O, HF, and NH_3. The boiling point of such compounds depends largely on the strength of the hydrogen bond and the number of the hydrogen bonds. The right decreasing order of the boiling points of the above compounds is :(i) HF > H_2O > NH_3(ii) H_2O > HF > NH_3(iii) NH_3 > HF > H_2O(iv) NH_3 > H_2O > HFAnswer 4. Option (ii) is the answer.Question 5. In the PO43- ion, formal charge on the oxygen atom of the PO bond is(i) + 1(ii) 1(iii) 0.75(iv) + 0.75Answer 5. Option (ii) is the answer.Question 6. In NO_3ion, the number of the bond pairs and lone pairs of electrons on the nitrogenatom is(i) 2, 2(ii) 3, 1(iii) 1, 3(iv) 4, 0Answer 6. Option (iv) is the answer.Question 7. Which of the following species will have tetrahedral geometry?(i) BH_4(ii) NH_2(iii) $CO_3$2-(iv) H_3O^+Answer 7. Option (i) is the answer.Question 8. The number of bonds and bonds in the following structure is(i) 6, 19(ii) 4, 20(iii) 5, 19(iv) 5, 20Answer 8. Option (iii) is the answer.Question 9. Which molecule/ ion out of the following does not contain unpaired electrons?(i) N_2+(ii) O_2(iii) $O_2$2-(iv) B_2Answer 09. Option (iii) is the answer.Question 10. In which of the following molecules and ions all the bonds are not equal?(i) XeF_4(ii) BF_4(iii) C_2H_4(iv) SiF_4Answer 10. Option (iii) is the answer.Question 11. In which of the following substances will the hydrogen bond be strongest?(i) HCl(ii) H_2O(iii) HI(iv) H_2SAnswer 11. Option (ii) is the answer.Question 12. If the electronic configuration of the element is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^2\ 4s^2$, thefour electrons involved in the chemical bond formation will be_____.(i) 3p6(ii) 3p6, 4s2(iii) 3p6, 3d2(iv) 3d2, 4s2Answer 12. Option (iv) is the answer.Question 13. Which of the following angles corresponds to sp2 hybridisation?(i) 90(ii) 120(iii) 180(iv) 109Answer 13. Option (ii) is the answerQuestion 14. Which of the given formulas may represent the stable form of A:(i) A(ii) A_2(iii) A_3(iv) A_4Answer 14. Option (i) is the answer.Question 15. Which of the given formulas may represent the stable form of C:(i) C(ii) C_2(iii) C_3(iv) C_4Answer 15. Option (ii) is the answer.Question 16. The molecular formula of the compound formed from the B and C will be(i) BC(ii) B_2C(iii) BC_2(iv) BC_3Answer 16. Option (iv) is the answer.Question 17. The bond in between B and C will be(i) Ionic(ii) Covalent(iii) Hydrogen(iv) CoordinateAnswer 17. Option (ii) is the answer.Question 18. Which of the following order of the energies of molecular orbitals of N_2 is correct?(i) $(2py) < (2pz) < (*2px) (*2py)$(ii) $(2py) > (2pz) > (*2px) (*2py)$(iii) $(2py) < (2pz) > (*2px) (*2py)$(iv) $(2py) > (2pz) < (*2px) (*2py)$Answer 18. Option (i) is the answer.Question 19. Which of the following statement is not right from the viewpoint of the molecularorbital theory?(i) Be_2 is not a stable molecule.(ii) He_2 is not stable but He_2+is expected to exist.(iii) Bond strength of N_2 is the maximum amongst the homonuclear diatomicmolecules belonging to the second period.(iv) The order of energies of the molecular orbitals in the N_2molecule is$2s < *2s < 2pz < (2px = 2py) < (*2px= *2py) < *2pz$Answer 19. Option (iv) is the answer.Question 20. Which of the following options represents the correct bond order :(i) O_2> O_2 > O_2+(ii) O_2< O_2 < O_2+(iii) O_2> O_2 < O_2+(iv) O_2< O_2 > O_2Answer 20. Option (ii) is the answer.Question 21. Explain the non-linear shape of H_2 S and the non-planar shape of PCl_3 using valence shell electron pair repulsion theory.Answer 21.In H_2S, the Sulphur atom is surrounded by four electron pairs (two bond pairs as well as two lone pairs).These four electron pairs adopt tetrahedral geometry.The repulsion in between lone pair electrons brings distortion in the shape of the H_2S.So, H_2S is not linear in shape.Question 22. Using the molecular orbital theory, compare the bond energy and magnetic character of O_2+ and O_2 species.Answer 22.The Molecular Orbital configuration of O_2+ as well as O-2 has given below:O_2+ (15): $1s^2\ *1s^2\ 2s^2\ *2s^2\ 2pz^2\ 2px^2 = 2py^2\ *2px1O_2$ (17): $1s^2\ *1s^2\ 2s^2\ *2s^2\ 2pz^2\ 2px^2 = 2py^2\ *2px^2= *2py1$Bond order for the O_2+ = 10-5/2 = 2.5Bond order for the O-2 = 10-7/2 = 1.5According to the Molecular Orbital Theory, the greater the bond order greater the bond energy.Thus, O_2+ is more stable than O_2Question 23. Explain the shape of BrF_5.Answer 23.BrF_5s central atom is bromine, which has the hybridisation sp^3d^2.Br atom has seven valence electrons, out of which five uses to make the pair with the F atoms, as well as two uses to make lone pairs of the electrons.The lone pair and the bond pair repel each other. So, the shape is square Pyramidal.Question 24. Structures of molecules of the two compounds are given below :(a) Which of the following two compounds will have intermolecular hydrogen bonding, and which compound expects to show the intramolecular hydrogen bonding?(b) The compounds melting point depends on, among other things, the extent of hydrogen bonding. Based on this, explain which of the above two compounds will show the higher melting point.(c) The solubility of compounds in the water depends on the power to form hydrogen bonds with water. Which of the above compounds will easily form a hydrogen bond with water and be more soluble?Answer 24.(a) Compound 1 will be having intramolecular hydrogen bonding in o-nitrophenolCompound (II) will have the intermolecular hydrogen bonding in p-nitrophenol.(b) The compound (II) has a higher melting point because of the intermolecular bonding, a large number of molecules that will get attached. (c) The compound (II) would be more soluble in water because it will easily form hydrogen bonding with the water molecules.Question 25. Why does the type of overlap given in the following figure does not result in formation of bond?Answer 25.In figure (i), the area of the contact of ++ overlap is equal to the area of the +- overlap. The so-net overlap is zero.In figure (ii), there is no overlap of the orbitals due to different symmetry.Question 26. Explain why PCl_5 is trigonal bipyramidal, whereas IF_5 is square Pyramidal.Answer 26.In PCl_5, P having the five valence electrons in the orbitals makes five bonds with 5 Cl atoms. It would share one of its electrons from the 3s to the 3d orbital. Therefore, the hybridisation will be sp^3d, and the geometry will be trigonal bipyramidal.IF_5, the Iodine atom, has seven valence electrons in the molecular orbitals. It will form 5 bonds with the 5 Cl atoms using 5 electrons from its molecular orbital, and two electrons will form one lone pair on the Iodine atom, which gives the square pyramidal geometry.Question 27. In both water and the dimethyl ether (CH_3 CH_3), the oxygen atom is the central atom and having the same hybridisation, yet they have different bond angles. Which one has a greater bond angle? Elaborate with a reason.Answer 27.Dimethyl ether will have a greater bond angle. There will be more repulsion in between bond pairs of CH_3 groups attached in ether than between bond pairs of the hydrogen atoms attached to oxygen in the water.Question 28. Write the Lewis structure of the following compounds and shows a formal chargeon each atom.HNO_3, NO_2, H_2SO_4Answer 28.The formal charge has been calculated byFormal charge = [total no: of bonding as well as shared electrons]The formal charge on oxygen with the single bond =6-6-2/2 = -1The formal charge on oxygen with the double bond 6-4-4/2 = 0The formal charge on the nitrogen=5-2-6/2 = 0The formal charge on oxygen 1 and 4 = 6-4-4/2= 0The formal charge on oxygen 2 and 3 = 6-4-4/2=0The formal charge on hydrogen 1 and 2 = 1-0-2/2=0The formal charge on sulfur =6-0-12/2 = 0Question 29. The energy of the 2pz molecular orbital is greater than 2px as well as 2py molecular orbitals in the nitrogen molecule. Write the complete sequence of the energy levels in the increasing order of the energy in the molecule. Compares the relative stability and the magnetic behaviour of the following species :N_2, N_2+ , N_2 , $N_2$2+Answer 29.General sequence of the energy level of the molecular orbital has$1s < *1s < 2s< *2s < 2px = 2py < 2pzN_2\ 1s^2\ *1s^2\ 2s^2\ *2s^2\ 2p2x = 2p2y\ 2p2zN_2$+ $1s^2\ *1s^2\ 2s^2\ *2s^2\ 2p2x = 2p2y\ 2p1zN_2\ 1s^2\ *1s^2\ 2s^2\ *2s^2\ 2p2x = 2p2y\ 2p2z\ 2p2xN_2$2+ $1s^2\ *1s^2\ 2s^2\ *2s^2\ 2p2x = 2p2y$thus, Bond order = [()electrons in BMO ()electrons in the ABMO]For N_2 = 10-4/2 = 3Bond order for N_2+= 9-4/2 = 2.5Bond order for N_2= 10-5/2 = 2.5Bond order for $N_2$2+= 8-4/2 = 2so, the order of stability is:N_2> N_2 > N_2+> $N_2$2+Question 30. What is the effect of the following process on the bond order in N_2 and O_2?(i) N_2 N_2+ + e-(ii) O_2 O_2+ + e-Answer 30.(i) N_2 will have 14 electrons when it donates one electron. These electrons remove from Bonding molecular orbital. as BO for N_2 = 3(ii) O_2 has 16 electrons, 8 electrons in the molecular orbitals and 4 in the antibonding molecular orbitals.BO for O_2 = 2Question 31. Give reasons for the following :(i) Covalent bonds are directional bonds, while ionic bonds are nondirectional.(ii) The water molecule has a bent structure, whereas the carbon dioxide molecule is linear.(iii) Ethyne molecule is linear.Answer 31.(i) A covalent bond is formed by overlapping atomic orbitals. The direction of the overlapping gives the direction of the bond.(ii) In the water molecule, the oxygen atom is sp^3 hybridised and has two lone pairs of electrons.(iii) In the ethyne molecule, both of the carbon atoms are sp hybridised. The two sp hybrid orbitals of both of the carbon atoms orient in the opposite direction as, forming an angle of 180.Question 32. What is the ionic bond? With two suitable examples, explain the difference in between an ionic and the covalent bond?Answer 32.When the positively charged ion forms a bond with a negatively charged ion, one atom transfers electrons to another. An example of the ionic bond is the chemical compound Sodium Chloride ($NaCl$).The difference between an ionic bond and a covalent bond is that an ionic bond essentially donates the electron to the other atom participating in the bond. In contrast, electrons in a covalent bond are shared equally between the atoms.Question 33. Arrange the following of the bonds in order to increase the ionic character, giving a reasonNH, FH, CH and OHAnswer 33.The ionic character is greater in the molecules with the highest electronegativity difference because the electron pair shifts toward the more electronegative atom, increasing the ionic character.Thus, the ionic character order will be:C-H