Important Questions for Class 11 Chemistry Chapter 4: Class 11 Chemistry Chapter 4, Chemical Bonding and Molecular Structure provide a collection of important questions with detailed answers to help students in their exam preparation.

These questions are created based on the CBSE syllabus and the latest academic guidelines. By practicing these questions, students can thoroughly review fundamental topics like bonding theories, hybridization, molecular shapes, and resonance. This practice not only strengthens conceptual clarity but also enhances problem-solving efficiency, making it easier to tackle board exams and competitive tests such as NEET and JEE with confidence. These resources are valuable for reinforcing knowledge and ensuring a thorough understanding of the subject.

Important Questions for Class 11 Chemistry Chapter 4 Overview

The important questions from Chapter 4 Chemical Bonding and Molecular Structure are important for Class 11 students as they often appear in exams and test a deep understanding of fundamental concepts.

These questions include topics like the explanation of ionic, covalent, and coordinate bonds, applications of the VSEPR theory to predict molecular shapes, and the concept of hybridization in molecules. Mastering these topics not only prepares students for their exams but also strengthens their foundation for advanced concepts in chemistry and competitive exams.

Important Questions for Class 11 Chemistry Chapter 4 PDF

Below, we have provided a comprehensive PDF containing important questions for Class 11 Chemistry Chapter 4 – Chemical Bonding and Molecular Structure. This PDF is created to help students understand crucial concepts such as ionic and covalent bonding, molecular geometry, hybridization, and resonance.

By practicing these questions, students can build a strong foundation and improve their problem-solving skills for exams. Download the PDF to begin your revision and gain confidence in mastering chemical bonding concepts.

Important Questions for Class 11 Chemistry Chapter 4 PDF

Important Questions for Class 11 Chemistry Chapter 4 Chemical Bonding and Molecular Structure

Below is the Important Questions for Class 11 Chemistry Chapter 4 Chemical Bonding and Molecular Structure-

1. Explain the non linear shape of H_2S and non planar shape of PCl_3 using valence shell electron pair repulsion theory.**Answer.**

The non-linear shape of **H_2S** and the non-planar shape of **PCl_3** can be explained using the **Valence Shell Electron Pair Repulsion (VSEPR) Theory**:

Non-linear Shape of H_2S: In H_2S, the central atom is sulfur (S), which has two lone pairs of electrons. According to VSEPR theory, electron pairs around a central atom tend to arrange themselves in a way that minimizes repulsion. In H_2S, sulfur has two bonding pairs (from the two H atoms) and two lone pairs of electrons. The lone pairs repel the bonding pairs more strongly, causing the H-S-H bond angle to be less than the ideal 109.5° (typical of a tetrahedral structure). As a result, the molecule adopts a **bent** or **non-linear** shape with an approximate bond angle of 92°.

Non-planar Shape of PCl_3: Phosphorus (P) in PCl_3 is the central atom and has three single bonds with chlorine (Cl) atoms and one lone pair of electrons. According to VSEPR theory, the three bonding pairs and one lone pair around phosphorus cause a **trigonal pyramidal** shape, which is a **non-planar** structure. The lone pair exerts greater repulsion than the bonding pairs, pushing the chlorine atoms downward, resulting in a non-planar shape. The bond angle in PCl_3 is slightly less than 109.5° due to the lone pair-bond pair repulsion.

2. Using molecular orbital theory, compare the bond energy and magnetic character of O_2^+ and O_2^- species.

Answer.

The electronic configurations of O_2^+ and O_2^- species are as follows:

In O_2^+ the bond order is (10 – 5)/2 = 2.5

In O_2^- the bond order is (10 – 7)/2 = 1.5

Bond dissociation energy is directly proportional to bond order, and unpaired electrons determine paramagnetic character. Both O_2^+ and O_2^- have high dissociation energy and are paramagnetic.

3. Explain the shape of BrF_5.

Answer.

In BrF_5 the central atom Br is surrounded by five bonded pairs and one lone pair. This forms the shape of square pyramidal

4. Structures of molecules of two compounds are given below:

(a) Which of the two compounds will have intermolecular hydrogen bonding and which compound is expected to show intramolecular hydrogen bonding.

(b) The melting point of a compound depends on, among other things, the extent of hydrogen bonding. On this basis explain which of the above two compounds will show higher melting point.

(c) Solubility of compounds in water depends on power to form hydrogen bonds with water. Which of the above compounds will form a hydrogen bond with water easily and be more soluble in it.

Answer.

(a) Since the NO_2 and OH groups in compound (I) are close together, intramolecular hydrogen bonding will form (II). Compound (II) will show intermolecular hydrogen bonding.

(b) Since it forms intramolecular hydrogen bonds, compound (II) has a higher melting point. As a result, more and more molecules are linked together via hydrogen bond formation.

(c) Due to intramolecular hydrogen bonding, compound (I) cannot form hydrogen bonds with water and is thus less soluble in it, whereas compound (II) can form hydrogen bonds with water more easily and is thus more soluble in water.

5. Why does type of overlap given in the following figure not result in bond formation?

Answer.

- In the first figure, the ++ overlap equals the +- overlap, so these cancel out and the net overlap is zero.
- Since the two orbitals are perpendicular to each other in the second figure, no overlap is possible.

6. Explain why PCl_5 is trigonal bipyramidal whereas IF_5 is square pyramidal.

Answer.

The difference in shapes between **PCl_5** and **IF_5** can be explained using the **Valence Shell Electron Pair Repulsion (VSEPR) Theory**:

PCl_5 (Trigonal Bipyramidal): In PCl_5, the central phosphorus (P) atom is surrounded by five bonding pairs of electrons (from the five chlorine atoms) and **no lone pairs**. According to VSEPR theory, five electron pairs around a central atom arrange themselves in a **trigonal bipyramidal** geometry to minimize electron pair repulsion. This shape consists of three positions in a plane (equatorial positions) and two positions above and below the plane (axial positions). The bond angles are 90° (axial-equatorial), 120° (equatorial-equatorial), and 90° (axial-axial).

IF_5 (Square Pyramidal): In IF_5, the central iodine (I) atom is surrounded by five bonding pairs of electrons (from the five fluorine atoms) and **one lone pair**. The presence of the lone pair causes more repulsion than bonding pairs, and this lone pair occupies one of the equatorial positions to minimize repulsion. As a result, the molecule adopts a **square pyramidal** geometry. Four fluorine atoms occupy the four equatorial positions in the plane, while one fluorine occupies the axial position, and the lone pair is positioned in one of the equatorial positions. The bond angles are slightly less than 90° and 120°, reflecting the lone pair's effect on the structure.

7. In both water and dimethyl ether (CH_3–O–CH_3), oxygen atom is central atom, and has the same hybridization, yet they have different bond angles. Which one has a greater bond angle? Give reason.

Answer.

The bond angle of dimethyl ether will be greater. More repulsion will exist between bond pairs of CH_3 groups attached in ether than between bond pairs of hydrogen atoms attached to oxygen in the water.

The carbon of CH_3 in ether is attached to three hydrogen atoms via bonds, and the electron pair of these bonds contribute to the electronic charge density on the carbon atom. As a result, the repulsion between two CH_3 groups will be greater than that between two hydrogen atoms.

8. Write Lewis structure of the following compounds and show a formal charge on each atom. HNO_2, NO_2, H_2SO_4

Answer.

- The Lewis structure of HNO_3 is
  Formal charge = Valence Electrons – Unbonded Electrons – ½ Bonded Electrons

Formal charge on O that has double bond = 6 – 4 –½ (4) = 0
Formal charge on O that is attached to H atom = 6 – 4 –½ (4) = 0
Formal charge on O that has single bond = 6 – 6 –½ (2) = – 1
Formal charge on H = 1 – 0 – ½ (2) = 0
Formal charge on N = 5 – 0 – ½ (8) = +1

- The Lewis structure of NO_2 is-

Formal charge = Valence Electrons – Unbonded Electrons – ½ Bonded Electrons
Formal charge on O that has double bond = 6 – 4 –½ (4) = 0
Formal charge on O that has single bond = 6 – 6 –½ (2) = – 1
Formal charge on N = 5 – 2 – ½ (6) =

9. The energy of σ2pz molecular orbital is greater than π2px and π2py molecular orbitals in nitrogen molecule. Write the complete sequence of energy levels in the increasing order of energy in the molecule. Compare the relative stability and the magnetic behaviour of the following species: N_2, N_2^+ , N_2^- , N_2^{2+}

Answer.

1. N_2 molecule has electronic configuration-
   $\sigma 1s^2, \sigma{*}1s^2, \sigma 2s^2, \sigma{*}2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$
   Here, $N_b = 10$, $N_a = 4$
   Hence, Bond Order = ½ $(N_b - N_a)$ = ½ (10 – 4) = 3
   The presence of no unpaired electron indicates it to be diamagnetic.
2. N_2^+ molecule has electronic configuration-
   $\sigma 1s^2, \sigma{*}1s^2, \sigma 2s^2, \sigma{*}2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^1$
   Here, $N_b = 9$, $N_a = 4$
   Hence, Bond Order = ½ $(N_b - N_a)$ = ½ (9 – 4) = 2.5
   The presence of 1 unpaired electron indicates it to be paramagnetic.
3. N_2^- molecule has electronic configuration-
   $\sigma 1s^2, \sigma{*}1s^2, \sigma 2s^2, \sigma{*}2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2, \pi{*}2p_x^1$
   Here, $N_b = 10$, $N_a = 5$
   Hence, Bond Order = ½ $(N_b - N_a)$ = ½ (10 – 5) = 2.5
   The presence of 1 unpaired electron indicates it to be paramagnetic.
4. N_2^{2+} molecule has electronic configuration-
   $\sigma 1s^2, \sigma{*}1s^2, \sigma 2s^2, \sigma{*}2s^2, \pi 2p_x^2 = \pi 2p_y^2$
   Here, $N_b = 8$, $N_a = 4$
   Hence, Bond Order = ½ $(N_b - N_a)$ = ½ (8 – 4) = 2
   The presence of no unpaired electron indicates it to be diamagnetic

Since bond dissociation energies are directly proportional to bond orders, the dissociation energies of these molecular species in the order are also proportional.

$N_2 > N_2^- = N_2^+ > N_2^{+2}$

In the above order, the greater the bond dissociation energy, the greater the stability of these species.

10. What is the effect of the following processes on the bond order in N_2 and O_2?

(i) $N_2 \rightarrow N_2^+ + e^-$

(ii) $O_2 \rightarrow O_2^+ + e^-$

Answer.

(i) $N_2 \rightarrow N_2^+ + e^-$

The bond order in N_2 is 3 while that in N_2^+ is 2.5. This indicates that the bond order decreases.

(ii) $O_2 \rightarrow O_2^+ + e^-$

The bond order in O_2 is 2 while that in O_2^+ is 2.5. This indicates that the bond order increases.

11. Give reasons for the following:

(i) Covalent bonds are directional bonds while ionic bonds are nondirectional.

(ii) Water molecule has bent structure whereas carbon dioxide molecule is linear.

(iii) Ethyne molecule is linear.

Answer.

(i) A covalent bond is formed by the overlapping of half-filled atomic orbitals with definite directions, i.e., shared electron pair/pairs are localised between two atoms. As a result, a covalent bond is also known as a directional bond. Since each ion in an ionic compound has an influence in all directions, it is surrounded by a number of oppositely charged ions with no definite direction and, therefore, is non-directional.

(ii) The central oxygen atom in water is sp^3 hybridised, whereas the central carbon atom in CO_2 is sp-hybridised. The net dipole moment of CO_2 is zero, whereas H_2O has a significant value. This demonstrates that CO_2 has a linear structure, whereas water has a bent structure.

(iii) Each carbon atom in ethyne is sp-hybridized, resulting in a linear structure.

12. What is an ionic bond? With two suitable examples explain the difference between an ionic and a covalent bond?

Answer.

Ionic bonds are chemical bonds formed between two atoms as a result of the transfer of one or more electrons from one atom to the other. Such a bond is only possible between atoms of different characteristics, with one atom having a tendency to lose electrons and the other atom having a tendency to accept electrons.

Distinctive features:

(i) Ionic bonds can form between dissimilar atoms, such as electropositive and electronegative atoms, whereas covalent bonds can form between similar and dissimilar atoms.

(ii) An ionic bond is neither rigid nor directional. It does not exhibit isomerism, whereas a covalent bond is rigid and directional, causing space isomerism.

13. Arrange the following bonds in order of increasing ionic character giving reason.

N – H, F – H, C – H and 0 – H.

Answer.

When there is a sufficient difference in the electronegativity of the two atoms, the ionic character is observed in a covalent bond.

Ionic character ∝ Electronegativity difference.

The following is an order of increasing ionic character.

C – H < N – H < O – H < F – H

14. Explain why CO_2^{2-} ion cannot be represented by a single Lewis structure. How can it be best represented?

Answer.

In the carbonate ion CO_3^{2-}. The lengths of the three C to O bonds are all the same. A single Lewis structure cannot demonstrate this. The ion is a composite of three different structures.

15. Predict the hybridization of each carbon in the molecule of organic compound given below. Also indicate the total number of sigma and pi bonds in this molecule.

Answer.

There are a total of 5 carbon atoms in the given structure:

- 2 are sp hybridised and linked through a triple bond.
- 2 are sp^2 hybridised and linked through double bonds to O atoms.
- 1 is sp^3 hybridised and linked to two carbon atoms and two H atoms through single bonds.

There are 11σ bonds and 4 π bonds in the molecule.

16. Group the following as linear and non-linear molecules:
H_2O, HOCl, $BeCl_2$, Cl_2O

Answer.

Only $BeCl_2$ is linear because the central atom O is surrounded by two lone pairs in the others.

Molecules are non-linear due to lone pair – lone pair repulsion.

H_2O, HOCl, Cl_2O are non-linear molecules.

17. Elements X, Y and Z have 4, 5 and 7 valence electrons respectively.

(i) Write the molecular formula of the compounds formed by these elements individually with hydrogen.

(ii) Which of these compounds will have the highest dipole moment?

Answer.

(i) The molecular formula of the compounds are as follows:

- XH_4
- YH_3
- ZH_1

(ii) X,Y, and Z each have 4,5 and 7 electrons. These elements are from the second period and the 14th, 15th, and 17th groups. The electronegativity of elements increases from group 1 to group 17.

As a result, H – Z will have the greatest dipole moment.

18. Draw the resonating structure of

(i) Ozone molecule

(ii) Nitrate ion

Answer.

(i) Ozone molecule

(ii) Nitrate ion

19. Predict the shapes of the following molecules on the basis of hybridization.

BCl_3, CH_4, CO_2, NH_3

Answer.

- BCl_3 has sp^2 hybridization and trigonal planar structure.
- CH_4 has sp^3 hybridization and tetrahedral structure.
- CO_2 has sp hybridization and linear structure.
- NH_3 has sp hybridization and pyramidal structure.

20. All the C-O bonds in carbonate ion (CO_3^{2-}) are equal in length. Explain.

Answer.

Carbon is bonded to three oxygen atoms in carbonate ion. It has double bonds with two oxygen atoms and a single bond with one oxygen. Since bonds are not fixed and show resonance, all C – O bonds are the same length.

Benefits of Solving Important Questions for Class 11 Chemistry Chapter 4

Solving important questions for Class 11 Chemistry Chapter 4 - Chemical Bonding and Molecular Structure provide several key benefits for students:

Strengthening Conceptual Understanding: By tackling these questions, students can gain a deeper understanding of fundamental concepts like ionic, covalent, and coordinate bonds, VSEPR theory, hybridization, and molecular geometry. This foundational knowledge is crucial for mastering more advanced topics in chemistry.

Improved Problem-Solving Skills: Important questions often include a variety of problem types, from basic theoretical questions to complex numerical problems. Regular practice helps students develop strong problem-solving abilities, which are essential for performing well in exams.

Time Management: By solving these questions under exam-like conditions, students learn to manage their time efficiently. This practice helps them become familiar with the exam format and understand how much time to allocate to different types of questions during the actual exam.

Better Exam Preparation: These questions cover key topics and frequently asked concepts, ensuring that students are well-prepared for the upcoming exams. Solving them not only boosts confidence but also helps students become familiar with the structure and difficulty level of the questions.

Helps in Competitive Exams: Many competitive exams like JEE and NEET also test concepts from **Chemical Bonding and Molecular Structure**. By solving important questions, students can enhance their preparation for these entrance exams, as the subject matter overlaps with topics tested in these exams.

Enhanced Retention: Regular practice reinforces learning and helps with better retention of complex concepts, making it easier to recall information during exams.

Building a Strong Foundation: Chemical bonding is a core topic in chemistry, and mastering it creates a solid foundation for understanding other chapters like organic chemistry, inorganic chemistry, and physical chemistry in later stages of study.