

IIT-JEE (ADVANCED)

CHAPTER TEST-4

CHEMISTRY

Topic : Chemical Bonding

M.M. : 80

Have patience all things are difficult before they become easy.

Instructions :

- (i) For each question in Section I, you will be awarded 3 Marks if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, minus one (– 1) mark will be awarded.
- (ii) For each question in Section II, you will be awarded 3 Marks if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, minus one (– 1) mark will be awarded.
- (iii) For each question in Section III, you will be awarded 3 Marks if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, minus one (– 1) mark will be awarded.
- (iv) For each question in Section IV, you will be awarded 2 marks for each row in which you have darkened the bubble(s) corresponding to the correct answer. Thus, each question in this section carries a maximum of 8 marks. There is no negative marking for incorrect answer(s) for this section.
- (v) For each question in Section V, you will be awarded 3 marks if you darken the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, minus one (–1) mark will be awarded.
- (vi) For each question in Section VI, you will be awarded 3 Marks if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, minus one (– 1) mark will be awarded.

SECTION - I

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE is correct.

Q.1 Select the incorrect statement about N_2F_4 and N_2H_4 :

- (I) In N_2F_4 , d-orbitals are contracted by electronegative fluorine atoms, but d-orbital contraction is not possible by H-atom in N_2H_4 .
(II) The N – N bond energy in N_2F_4 is more than N – N bond energy in N_2H_4
(III) The N – N bond length in N_2F_4 is more than that of in N_2H_4
(IV) The N – N bond length in N_2F_4 is more less than that of in N_2H_4

Choose the correct code :

- (A) I, II and III (B) I and III (C) II and IV (D) II and III

Q.2 Select pair of compounds in which both have different hybridization but have same molecular geometry.

- (A) BF_3 , BrF_3 (B) $ICl_2^{\ominus}$, $BeCl_2$ (C) BCl_3 , PCl_3 (D) PCl_3 , NCl_3

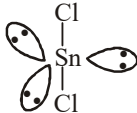
Q.3 The bond order of N_2^- anion is -

- (A) 1 (B) 2 (C) 2.5 (D) 3

Q.4 Which of the following has maximum bond strength –

- (A) O_2 (B) O_2^+ (C) O_2^- (D) O_2^{2-}

Q.5 The atomic number of Sn is 50. The shape of gaseous $SnCl_2$ molecule is :

- (A) $Cl - Sn - Cl$ (B)  (C)  (D) 

Q.6 The compound which contains both covalent and co-ordinate bond is -

- (A) C_2H_5NC (B) C_2H_5CN (C) HCN (D) None

Q.7 The type of bond present in N_2O_5 are -

- (A) Only covalent (B) Only ionic (C) Ionic and covalent (D) Covalent and coordinate

Q.8 Which is not true according to VBT -

- (A) A covalent bond is formed by the overlapping of orbitals with unpaired electrons of opposite spins.
(B) A covalent bond is formed by the overlapping of orbitals with unpaired electrons of same spin.
(C) The greater the extent of overlapping the stronger is the bond.
(D) Overlapping takes place only in the direction of maximum electron density of the orbital.

SECTION - II

This section contains 3 multiple choice questions . Each question has 4 choices (A), (B), (C) and (D), out of which one or more answers are correct.

Q.9 Which of the following process is/are associated with change of hybridization of the underlined compound ?

- (A) $Al(OH)_3$ ppt. dissolved in NaOH
(B) B_2H_6 is dissolved in THF
(C) SiF_4 vapour is passed through liq. HF
(D) Solidification PCl_5 vapour

Q.10 In the structure of H_2CSF_4 , which of the following statement is/are correct –

- (A) Two C – H bonds are in the same plane of axial S – F bonds
- (B) Two C – H bonds are in the same plane of equatorial S – F bonds
- (C) Total six atoms are in the same plane
- (D) Equatorial S – F plane is perpendicular to plane of π -bond

Q.11 Choose the correct statements –

- (A) The co-ordinate bond is called semi polar bond
- (B) The reaction of covalent compound are slow
- (C) When two atoms combine to form a molecule energy is released
- (D) AlI_3 is more covalent than AlBr_3

SECTION - III

This section contains paragraph. Based upon each paragraph, 3 multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D), out of which only one is correct.

Passage (Q.12-Q.14)

Polar covalent molecules exhibit dipole moment. Dipole moment is equal to the product of charge separation, q and the bond length d for the bond. Unit of dipole moment is debye. One debye is equal to 10^{-18} esu cm.

Dipole moment is a vector quantity. It has both magnitude and direction. Hence, dipole moment of a molecule depends upon the relative orientation of the bond dipoles, but not on the polarity of bonds alone. A symmetrical structure shows zero dipole moment. Thus, dipole moment helps to predict the geometry of a molecules. Dipole moment values can be used to distinguish between cis- and trans-isomers, ortho-, meta- and para-forms of a substance, etc.

Q.12 Which is a polar molecule –

- (A) XeF_4 (B) BF_3 (C) I_2Cl_6 (D) PCl_2F_3

Q.13 A diatomic molecule has a dipole moment of 1.2D . If the bond length is 1.0×10^{-8} cm, what fraction of charge does exist each atom ?

- (A) 0.1 (B) 0.2 (C) 0.25 (D) 0.3

Q.14 Arrange the following compounds in increasing order of dipole moments, toluene (I) o-dichlorobenzene (II), m-dichlorobenzene (III) and p-dichlorobenzene (IV).

- (A) $\text{IV} < \text{I} < \text{II} < \text{III}$ (B) $\text{I} < \text{IV} < \text{II} < \text{III}$ (C) $\text{IV} < \text{I} < \text{III} < \text{II}$ (D) $\text{IV} < \text{II} < \text{I} < \text{III}$

Passage (Q.15-Q.17) :

The distribution of electrons among various molecular orbitals is called the electronic configuration of the molecule which provides us the following very important information about the molecule.

(A) Stability of molecule : The molecule is stable if number of bonding molecular orbital electrons (N_b) is greater than the number of antibonding molecular orbital electrons (N_a).

(B) Bond order : Bond order = $\frac{1}{2} (N_b - N_a)$

A positive bond order means a stable molecule while a negative or zero bond order means an unstable molecule.

(C) Nature of the bond : Bond order 1, 2 and 3 corresponds to single, double and triple bonds respectively.

(D) Bond length : Bond length decreases as bond order increases.

(E) Magnetic nature : Molecular orbitals in a molecule are doubly occupied, the substance is diamagnetic and if one or more molecular orbitals are singly occupied, it is paramagnetic.

- Q.15** Which of the following statement is incorrect –
 (A) Among O_2^+ , O_2 and O_2^- the bond length decreases as $O_2^- > O_2$ and O_2^+
 (B) He_2 molecule does not exist as the bonding and anti-bonding orbitals cancel each other
 (C) C_2 , O_2^{2-} and Li_2 are diamagnetic
 (D) In F_2 molecule, the energy of σ_{2p_z} is more than π_{2p_x} and π_{2p_y}
- Q.16** The following molecules/species have been arranged in the order of their increasing bond orders. Identify the correct order : (I) O_2 ; (II) O_2^- (III) O_2^{2-} ; (IV) O_2^+
 (A) III < II < I < IV (B) IV < III < II < I (C) III < II < IV < I (D) II < III < I < IV
- Q.17** N_2 has greater dissociation energy than N_2^+ , where as O_2 has a lower dissociation energy than O_2^+ because –
 (A) bond order is reduced when O_2 is ionized to O_2^+ and bond order is increased when N_2 is ionized to N_2^+
 (B) bond order is increased when O_2 is ionized to O_2^+ and bond order is decreased when N_2 is ionized to N_2^+
 (C) bond order is decreased when O_2 is ionized to O_2^+ and bond order is increased when N_2 is ionized to N_2^+
 (D) None of these

SECTION - IV

This section contains match the column question . Four statements (A, B, C and D) are given in column I and four/five statements (p, q, r, s and t) in Column II. Any given statement in column I can have correct matching with one or more statement(s) given in column II.

- Q.18** Match the column –

Column I

- (A) NH_4Cl
 (B) $CuSO_4 \cdot 5H_2O$
 (C) HNC
 (D) Liquid H_2O_2

Column II

- (p) Hydrogen bond
 (q) Co-ordinate bond
 (r) Ionic bond
 (s) Covalent bond

SECTION - V

This section contains 5 questions . The answer to each of the questions is a single digit integer, ranging from 0 to 9.

- Q.19** No. of covalent bond in pyrosulphuric acid are–
Q.20 Allyl cyanide has x sigma bonds, y pi bonds and z lonepairs. Find $x + y + z - 4$.
Q.21 The dipole moment of KCl is 3.336×10^{-29} Cm. The interatomic distance K^+ and Cl^- ion in KCl is 260 pm. Calculate the dipole moments of KCl, if there were opposite charges of the fundamental unit located at each nucleus. The percentage ionic character of KCl is x%. Find the integral value of x/10.
Q.22 Choose the correct no. of statements.
 (A) $CaCl_2$ obeys Octet rule.
 (B) $FeCl_2$ does not obey Octet rule.
 (C) Ions are formed from neutral atoms by loss and gain of electrons
 (D) Ions are formed from neutral atoms by sharing of electrons

(E) Valency expresses combining capacity of an element

(F) Valency expresses atomicity of an element.

Q.23 In a regular octahedral molecule, MX_6 , the number $X - M - X$ bonds at 180° is –

SECTION - VI

This section contains 2 questions. Each questions contain STATEMENT-1 (Assertion) and STATEMENT-2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which ONLY ONE is correct.

(A) Statement- 1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement -1.

(B) Statement -1 is True, Statement -2 is True ; Statement-2 is NOT a correct explanation for Statement - 1.

(C) Statement - 1 is True, Statement- 2 is False.

(D) Statement -1 is False, Statement -2 is True.

Q.24 Statement 1 : $(CH_3)_3N$ geometry is pyramidal but in case $(SiH_3)_3N$ it is planar.

Statement 2 : The maximum covalency of Si is six but that of C is four.

Q.25 Statement 1 : LiCl is essentially a covalent compound

Statement 2 : Electronegativity difference between Li and Cl is too small.