



GOVERNMENT OF KARNATAKA

DEPARTMENT OF SCHOOL EDUCATION (PRE-UNIVERSITY)

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CHAPTERWISE MULTIPLE CHOICE QUESTIONS FOR COMPETATIVE EXAM

SUBJECT: I PUC CHEMISTRY

NAME OF THE CHAPTER: UNIT: 04-Chemical bonding and Molecular structure

Synopsis

➤ The tendency of atoms to acquire a maximum of 8 electrons in the valence shell is called octet rule. However this rule is not universally applicable. All such stable molecules which contain less than 8 electrons in the valence shell are called electron deficient while molecules which contain more than 8 electrons in the valence shell are called hypervalent compounds.

➤ Factors favouring the formation of ionic bond are, low ionization energy for the atom forming the cation, high electron affinity for atom accepting the electron and high lattice enthalpy for the crystal formed.

➤ Factors affecting the formation of covalent bond are, high electron affinity for combining atoms, electronegativity but small difference in the value for the combining atoms, small size of combining atoms, high ionization energy for atoms.

➤ VSEPR theory is used to explain the shapes of simple covalent molecules. If the central atom in the molecule is surrounded by only bond pairs of electrons, molecule has regular geometry. Otherwise it has irregular geometry. This distortion is due to lone pair-lone pair repulsion > lone pair-bond pair > bond pair-bond pair.

➤ **Molecular orbital theory (MOT)**

Linear combination of atomic orbitals

Atomic orbitals undergo combination by linear combination of atomic orbitals method. (LCAO)

Condition to be satisfied for LCAO

a) Atomic orbitals with same energy and same wave nature can overlap to form molecular orbitals.

b) The extent of overlapping should be large.

➤ Let Ψ_A and Ψ_B be the wave functions of combining atomic orbitals of A and B respectively.

Probability of finding the electron in the molecular orbital formed by addition overlapping is $(\Psi_{A+B})^2$

$$(\Psi_A + \Psi_B)^2 = \Psi_A^2 + \Psi_B^2 + 2 \Psi_A \Psi_B$$

$$(\Psi_A + \Psi_B)^2 > \Psi_A^2 + \Psi_B^2$$

Probability of finding the electron in the molecular orbital formed by subtraction overlapping is $(\Psi_A - \Psi_B)^2$

$$(\Psi_A - \Psi_B)^2 = \Psi_A^2 + \Psi_B^2 - 2 \Psi_A \Psi_B$$

$$(\Psi_A - \Psi_B)^2 < \Psi_A^2 + \Psi_B^2$$

- The atomic orbitals in a molecule completely lose their identity after the formation of molecular orbital. The molecule is quite different from the combining atomic orbitals. Molecule is polycentric. Electron moves in the field of more than one nucleus. Electrons are delocalized.
- Bonding molecular orbital has lesser energy than the anti-bonding molecular orbital.
- Molecular orbitals are filled in accordance with Aufbau principle, Pauli's Exclusion principle and Hund's rule of maximum multiplicity.
- Bond order = $\frac{1}{2}$ (No. of e^- in BMO - No. of e^- in ABMO)
- 1. Molecule is stable if the value of bond order is positive. It is unstable if the value is zero or negative.
- 2. Stability molecule is directly proportional to bond order.
- Order of filling of molecular orbitals is
 $\sigma_{1s} < \sigma^*_{1s} < \sigma_{2s} < \sigma^*_{2s} < \sigma_{2pz} < \pi_{2px} = \pi_{2py} < \pi^*_{2px} = \pi^*_{2py} < \sigma^*_{2pz}$
- Hydrogen bond is an attractive between hydrogen atom and highly electronegative atoms like N or O or F belonging to the same or different molecule. It is weaker than covalent bond.

4.1 Kossel-Lewis approach to chemical bonding

1. According to Lewis, the nucleus plus the inner electrons of an atom refer to

(a) Kernel	(b) valence shell
(c) non bonded electrons	(d) lone pair of electrons
2. The bond formed as a result of the electrostatic attraction between the positive and negative ions was termed as the

(a) covalent bond	(b) metallic bond
(c) coordinate bond	(d) electrovalent bond
3. Kossel assigned electrovalence to ions. Calcium is assigned

(a) positive electrovalence of one	(b) positive electrovalence of two
(c) negative electrovalence of two	(d) negative electrovalence of one.
4. In the Lewis dot structure of water, duplet and octet of electrons are attained respectively by the atoms

(a) O and O	(b) O and H
(c) H and O	(d) H and H
5. Read the following statements and select the correct option from the choices given:
 Statement I : The total number of electrons required for writing the Lewis dot structure are obtained by adding the valence electrons of the combining atoms.
 Statement II : In general , the least electronegative atom occupies the central position in the molecule.

(a) statements I and II are correct	(b) statements I and II are incorrect
(c) statement I is correct and statement II is incorrect	(d) statement I is incorrect and statement II is correct.
6. Which of the following atom attains the electronic configuration of helium in the compounds mentioned with it?

(a) O in H_2O	(b) H in H_2O
(c) N in NH_3	(d) Cl in HCl
7. The total number of lone pair of electrons in the Lewis dot structure of carbon monoxide is

- (a) two pairs (b) one pair
(c) three pairs (d) four pairs.

8. The formal charge on central oxygen atom in ozone is

- (a) 0 (b) +2
(c) +1 (d) -1

(KCET 2020)

9. The difference between the number of valence electrons and of the atom in an isolated state and the number of electrons assigned to that atom in the Lewis structure of a polyatomic molecule or ion is

- (a) anionic charge (b) cationic charge
(c) formal charge (d) number of atoms

10. In which of the following compounds the central atom fails to satisfy the octet rule?

- (a) BCl_3 (b) H_2O
(c) NH_3 (d) CH_4

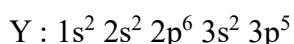
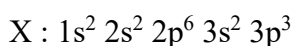
11. The compound without expanded octet for the central atom is

- (a) PF_5 (b) SF_6
(c) H_2SO_4 (d) CH_4

12. Which of the following is TRUE for the octet rule?

- (a) it explains the shape of molecules
(b) it explains the relative stability of the molecules
(c) it explains the structures of most of the organic compounds
(d) it is applicable to molecules with an odd number of electrons.

13. The electronic configuration of X and Y are given below:



Which of the following is the correct molecular formula and the type of bond formed between X and Y?

- (a) X_3Y , ionic bond (b) X_2Y_3 , coordinate bond
(c) XY_3 , covalent bond (d) X_2Y , covalent bond. (KCET 2025)

14. With respect to resonance structures of CO_3^{2-} ion, which of the following statements are correct?

- A) All C-O bonds in CO_3^{2-} are equivalent
B) There are three resonance structures possible for CO_3^{2-} ion.
C) The position of carbon and oxygen should change in every resonance structure.
D) The formal charge on carbon atom is -2.

- (a) A, B and C (b) A and B only
(c) B and D only (d) A, B and D . (KCET 2026)

4.2 ionic or electrovalent bond:

15. The type of bond which is formed easily between elements with comparatively low ionization enthalpy and elements with comparatively high negative value of electron gain enthalpy is

- (a) metallic bond (b) ionic bond
(c) coordinate bond (d) covalent bond

16. The stability of an ionic compound is mainly provided by its

- (a) octet of electrons (b) ionization enthalpy
(c) electron gain enthalpy (d) enthalpy of lattice

17. The lattice enthalpy of NaCl is 788 kJ mol^{-1} . The quantity of energy required to separate half mole of solid NaCl into half mole of gaseous sodium ions and half mole of gaseous chloride ions to an infinite distance is

- (a) 1576 kJ (b) 3940 kJ
(c) 394 kJ (d) 788 kJ.

18. HCl gas is covalent and NaCl is an ionic compound. This is because

- (a) sodium is highly electropositive
(b) hydrogen is a non-metal
(c) HCl is a gas
(d) electronegativity difference between H and Cl is less than 2.1.

(KCET 2016)

4.3 Bond parameters:

19. Which of the following is a correct statement?

- (a) In a covalent molecule of the type AB, bond length is the average of covalent radii of atoms A and B.
(b) Bond length can be measured by spectroscopic, X-ray diffraction and electron diffraction techniques.
(c) H-H bond length in H_2 is greater than that of F-F bond length in F_2 .
(d) H-O-H bond angle in water is 180° .

20. The unit of bond enthalpy is

- (a) kJ mol (b) kJ mol^{-1} .
(c) kJ mol^3 (d) kJ mol^2

21. Read the following statements and select the correct option from the given choices:

Statement-I : Larger the bond dissociation enthalpy, stronger will be the bond in the molecule.

Statement II : In water molecule, the enthalpy required to break the two O-H bonds is the same.

- (a) statements I and II are correct
(b) statements I and II are incorrect
(c) statement I is correct and statement II is incorrect
(d) statement I is incorrect and statement II is correct

22. F_2 and O_2^{2-} are isoelectronic. They have the same

- (a) bond angle (b) bond order
(c) bond length (d) number of protons

23. Experimentally determined oxygen-oxygen bond lengths in ozone are same. This indicates,

- (a) structure of ozone is best represented by the resonance hybrid of the two canonical structures.

- (b) structure of ozone can be represented by either of the two Lewis structures.
- (c) canonical structures are the best structures for ozone.
- (d) oxygen – oxygen bonds are single bonds.
24. Which of the following cannot be represented by resonance structures?
- (a) carbonate ion (b) ozone
- (c) carbon dioxide (d) Hydrogen chloride
25. The number of canonical forms in carbonate ion is
- (a) 1 (b) 2
- (c) 0 (d) 3
26. Which of the following is correct with respect to the property mentioned with it?
- (a) energy: O_3 resonance hybrid < canonical form of O_3
- (b) bond length : $HI < HF$
- (c) bond enthalpy : $O_2 > N_2$
- (d) bond order : $O_2 > N_2$
27. The product of the magnitude of the charge and the distance between centres of positive and negative charge in a bond is called
- (a) magnetic moment (b) dipole moment
- (c) bond length (d) bond enthalpy
28. For a non-polar molecule, the net dipole moment is equal to
- (a) 1 (b) zero
- (c) 1.5 (d) 2.3
29. Which one of the following is not same for NH_3 and NF_3 molecules?
- (a) shape (b) number of covalent bonds
- (c) resultant dipole moment (d) central atom
30. The covalent character of a bond is increased when
- (a) the size of cation is large (b) the size of anion is small
- (c) the charge on cation is large (d) the charge on cation is small
31. Which has maximum covalent character?
- (a) LiF (b) LiCl
- (c) LiI (d) LiBr.
32. Match List-I with List-II and select the correct option:

List-I (Molecule /ion)	List-II (Bond order)
1. NO	i. 1.5
2. CO	ii. 2.0
3. O_2^-	iii. 2.5
4. O_2	iv. 3.0

- (a) 1-iii, 2-iv, 3-i , 4-ii (b) 1-i, 2-iv, 3-iii , 4-ii
- (c) 1-ii, 2-iii, 3-iv , 4-i (d) 1-iv, 2-iii, 3-ii , 4-i.

(KCET 2025)

33. Which of the following statement is INCORRECT? (KCET 2023)

- (a) bond length of $O_2 <$ bond length of O_2^{2-} (b) bond length of $O_2 >$ bond length of O_2^{2-}
(c) bond length of $O_2 >$ bond length of O_2^{2+} (d) bond length of $O_2^+ <$ bond length of O_2^{2-}

34. Which of the following possess net dipole moment?

- (a) SO_2 (b) BF_3
(c) $BeCl_2$ (d) CO_2 (KCET 2019)

4.4 Valence shell electron pair repulsion theory:

35. According to VSEPR theory, the correct order of repulsive interaction of electron pairs : lone pair (lp)- lone pair (lp), lone pair (lp)-bond pair (bp) and bond pair(bp)-bond pair(bp) is

- (a) $bp-bp > lp-bp > lp-lp$ (b) $lp-lp > bp-bp > lp-bp$
(c) $lp-lp > lp-bp > bp-bp$ (d) $lp-lp > bp-bp > lp-bp$

36. Which of the following is a correct match with respect to the shape of the molecule?

- (a) H_2O - linear (b) $BeCl_2$ - linear
(c) CH_4 - pyramidal (d) NH_3 - trigonal planar

37. The central atom of a molecule has four bonding pair of electrons and one lone pair of electrons. Predicted geometry of the molecule is

- (a) see saw (b) T-shape
(c) square planar (d) square pyramidal

38. 'A' is the central atom, 'B' is the atom bonded to 'A'. E indicates the number of lone pair of electrons. The molecules of the type AB_2E_2 and AB_3E respectively have the geometry

- (a) bent, see saw (b) bent, trigonal pyramidal
(c) trigonal pyramidal, bent (d) T-shape, linear.

39. The type of hybrid orbitals of nitrogen in NO_2^+ , NO_3^- and NH_4^+ are

- (a) sp, sp^2 and sp^3 (b) sp, sp^3 and sp^2
(c) sp^2 , sp and sp^3 (d) sp^2 , sp^3 and sp. (KCET 2026)

4.5 Valence bond theory:

40. s-s overlapping and s-p overlapping of atomic orbitals results in the formation of

- (a) pi bond (b) sigma bond
(c) double bond (d) triple bond.

41. Which of the following is true about a sigma bond?

- (a) sigma bond is formed by sideways overlapping of atomic orbitals
(b) sigma bond is always weaker than a pi bond
(c) sigma bond is stronger than pi bond
(d) s-s overlapping of atomic orbitals result in pi bond.

42. Which of the following structure of a molecule is expected to have three bond pairs and one lone pair of electrons?

- (a) trigonal planar (b) tetrahedral
(c) octahedral (d) pyramidal (KCET 2017)

4.6 Hybridisation:

43. Which one of the following is not a salient feature of hybridisation?
- (a) The hybridised orbitals are always equivalent in energy and shape
 - (b) The hybrid orbitals are more effective in forming the stable bonds than the pure atomic orbitals
 - (c) The type of hybridisation indicates the geometry of the molecule
 - (d) The number of hybrid orbitals is twice the number of atomic orbitals hybridised.
44. The molecule having sp hybridisation is
- (a) BCl_3
 - (b) $BeCl_2$
 - (c) NH_3
 - (d) CH_4
45. The number of sp^2 - sp^2 sigma bonds and sp^2 -s in ethene respectively are
- (a) 1 and 3
 - (b) 4 and 1
 - (c) 3 and 2
 - (d) 1 and 4
46. A molecule has square planar geometry. The type of hybridisation is
- (a) sp^3
 - (b) sp^2
 - (c) d^2sp^3
 - (d) dsp^2
47. The number of equatorial and axial P-Cl bonds in PCl_5 respectively are
- (a) 3 and 2
 - (b) 2 and 3
 - (c) 3 and 5
 - (d) 3 and 1
48. SF_6 molecule has
- (a) a regular tetrahedral geometry
 - (b) a regular octahedral geometry
 - (c) a distorted pyramidal geometry
 - (d) a square planar geometry.
49. Which of the following conversion involve change in both hybridisation and shape?
- (a) $CH_4 \rightarrow C_2H_6$
 - (b) $NH_3 \rightarrow NH_4^+$
 - (c) $BF_3 \rightarrow BF_4^-$
 - (d) $H_2O \rightarrow H_3O^+$
- (KCET 2015)**
50. Hybridised states of carbon in graphite and diamond respectively are
- (a) sp , sp^3
 - (b) sp^3 , sp^2
 - (c) sp^2 , sp^2
 - (d) sp^2 , sp^3
- (KCET 2013)**
51. The pair of compounds having identical shapes for their molecules is
- (a) CH_4 , SF_4
 - (b) BCl_2 , ClF_3
 - (c) XeF_2 , $ZnCl_2$
 - (d) SO_2 , CO_2
- (KCET 2014)**

4.7 Molecular orbital theory:

52. The number of molecular orbitals formed by the combination of two atomic orbitals is
- (a) 1
 - (b) 3
 - (c) 2
 - (d) 4
53. Antibonding molecular orbitals are formed
- (a) by the addition overlapping of atomic orbitals
 - (b) by the constructive interference of electron waves
 - (c) by the subtraction overlapping of atomic orbitals
 - (d) with high electron density between the nuclei of combining atoms.

54. The molecular orbital having higher energy than $\sigma 2p_z$ is
 (a) $\sigma^* 1s$ (b) $\sigma^* 2s$
 (c) $\sigma 1s$ (d) $\sigma^* 2p_z$
55. N_b is the number of electrons in bonding molecular orbitals and N_a is the number of electrons in the antibonding molecular orbitals. The molecule is stable if
 (a) $N_b = N_a$ (b) $N_b > N_a$
 (c) $N_b < N_a$ (d) $N_b - N_a = 0$
56. Using MOT, compare O_2^+ and O_2^- species and choose the correct option.
 (a) O_2^- is less stable
 (b) both O_2^+ and O_2^- are paramagnetic
 (c) O_2^+ has higher boiling point than O_2^-
 (d) O_2^+ is diamagnetic whereas O_2^- is paramagnetic. **(KCET 2015)**
57. Main axis of diatomic molecule is z. The orbitals p_x and p_z overlap to form
 (a) Π molecular orbital (b) σ - molecular orbital
 (c) δ -molecular orbital (d) no bond is formed. **(KCET 2016)**
- 4.8 Bonding in some homonuclear diatomic molecules:**
58. Li_2 molecule has a bond order of x. The number of unpaired electrons in the molecular orbitals of Li_2 is y. Then x and y respectively are
 (a) 0 and 1 (b) 1 and 0
 (c) 2 and 2 (d) 2 and 0
59. O_2 molecule has unpaired electrons in
 (a) $\sigma^* 2p_z$ orbital (b) $\sigma 2p_z$ orbital
 (c) $\sigma 2s$ orbital (d) $\Pi^* 2p_x$ and $\Pi^* 2p_y$ orbitals
60. C_2 molecule consists of
 (a) two sigma bonds (b) two pi bonds
 (c) one sigma and one pi bonds (d) two sigma bonds
61. Which one of the following is paramagnetic?
 (a) H_2 (b) O_2
 (c) C_2 (d) Li_2
62. Arrange the following in the increasing order of their bond order for O_2 , O_2^+ , O_2^- and O_2^{2-} .
 (a) $O_2^{2-}, O_2^-, O_2^+, O_2$. (b) $O_2^+, O_2, O_2^-, O_2^{2-}$.
 (c) $O_2, O_2^+, O_2^-, O_2^{2-}$ (d) $O_2^{2-}, O_2^-, O_2^+, O_2$. **(KCET 2016)**
63. Which of the following is diamagnetic?
 (a) H_2^+ (b) He_2^+
 (c) O_2 (d) N_2 **(KCET 2013)**
64. The number of antibonding electrons present in O_2^- molecular ion is
 (a) 8 (b) 6
 (c) 5 (d) 7 **(KCET 2013)**

65. In oxygen and carbon molecule, the bonding is

(a) $O_2 : 1\sigma, 1\pi$; $C_2 : 0\sigma, 2\pi$

(b) $O_2 : 0\sigma, 2\pi$; $C_2 : 2\sigma, 0\pi$

(c) $O_2 : 1\sigma, 1\pi$; $C_2 : 1\sigma, 1\pi$

(d) $O_2 : 2\sigma, 1\pi$; $C_2 : 0\sigma, 2\pi$ (KCET 2022)

4.9 Hydrogen bonding:

66. The attractive force which binds hydrogen atom of one molecule with the electronegative atom (F or O or N) of another molecule is called

(a) covalent bond

(b) metallic bond

(c) hydrogen bond

(d) disulphide bond

67. The incorrect information about hydrogen bond is

(a) hydrogen bond is weaker than covalent bond

(b) the extent of hydrogen bond is maximum in the solid state

(c) the extent of hydrogen bond is maximum in gaseous state

(d) HF molecules have inter molecular hydrogen bond in them

68. In o-nitrophenol, intra molecular hydrogen bond is present between

(a) O and H atoms

(b) N and H atoms

(c) O and N atoms

(d) H and C atoms

69. The correct order of boiling point in the following compounds is

(a) $HF > H_2O > NH_3$

(b) $H_2O > HF > NH_3$

(c) $NH_3 > H_2O > HF$

(d) $NH_3 > HF > H_2O$

(KCET 2021)

70. The intermolecular hydrogen bond is present in

(a) phenol

(b) o-nitrophenol

(c) p-nitrophenol

(d) p-cresol.

(KCET 2018)

Answer key

1	2	3	4	5	6	7	8	9	10
a	b	b	c	a	b	a	c	c	a
11	12	13	14	15	16	17	18	19	20
d	c	c	b	b	d	c	d	b	b
21	22	23	24	25	26	27	28	29	30
c	b	a	d	d	a	b	b	c	c
31	32	33	34	35	36	37	38	39	40
c	a	d	a	c	b	a	b	a	b
41	42	43	44	45	46	47	48	49	50
c	d	d	b	d	d	a	b	c	d
51	52	53	54	55	56	57	58	59	60
c	c	c	d	b	d	a	b	d	b
61	62	63	64	65	66	67	68	69	70
b	d	d	d	a	c	c	a	b	c
