CHEMISTRY CC04

SYLLABUS : Chemical bonding and Molecular Structure

Max. Marks : 180 **Marking Scheme :** + 4 for correct & (–1) for incorrect **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 45 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. The electronic configuration of metal M is $1s^2\ 2s^2\ 2p^6\ 3s^1$. The formula of its oxide will be
(a) MO (b) M_2O
(c) SO_3 (d) All of these

2. Which of the following does not contain coordinate bond ?
(a) $BH_4^{\cdot\cdot}$ (b) NH_4^+
(c) CO_3^{2-} (d) H_3O^+

3. Which of the following statements is incorrect ?
(a) The formation of ionic compounds depend upon the ease of formation of the positive and negative ions from the respective neutral atoms.
(b) Formation of ionic compounds depend upon arrangement of the positive and negative ions in the solid.
(c) Formation of positive ion involves addition of electron(s) while that of negative ion involves removal of electron(s).
(d) None of these

4. Hybridisation of the underline atom changes in:
(a) $\underline{Al}H_3$ changes to AlH_4^-
(b) $H_2\underline{O}$ changes to H_3O^+
(c) $\underline{N}H_3$ changes to NH_4^+
(d) in all cases

5. The decreasing values of bond angles from NH_3 (106°) to SbH_3 (101°) down group-15 of the periodic table is due to
(a) decreasing lp-bp repulsion
(b) decreasing electronegativity
(c) increasing bp-bp repulsion
(d) increasing p-orbital character in sp^3

6. In PO_4^{3-}, the formal charge on each oxygen atom and the P – O bond order respectively are
(a) –0.75, 0.6 (b) –0.75, 1.0
(c) –0.75, 1.25 (d) –3, 1.25

7. KF combines with HF to form KHF_2. The compound contains the species
(a) K^+, F^- and H^+ (b) K^+, F^- and HF
(c) K^+, and $[HF_2]^-$ (b) $[KHF]^+$ and F_2

RESPONSE GRID					
1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ
6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ			

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8. An ether is more volatile than an alcohol having the same molecular formula. This is due to
(a) dipolar character of ethers
(b) alcohols having resonance structures
(c) inter-molecular hydrogen bonding in ethers
(d) inter-molecular hydrogen bonding in alcohols

9. In which of the following ionization processes, the bond order has increased and the magnetic behaviour has changed?
(a) $N_2 \rightarrow N_2^+$ (b) $C_2 \rightarrow C_2^+$
(c) $NO \rightarrow NO^+$ (d) $O_2 \rightarrow O_2^+$.

10. The maximum number of 90° angles between bond pair-bond pair of electrons is observed in
(a) dsp^2 hybridization (b) sp^3d hybridization
(c) dsp^3 hybridization (d) sp^3d^2 hybridization

11. Two ice cubes are pressed over each other until they unite to form one block. Which one of the following forces dominate for holding them together?
(a) Dipole-dipole interaction
(b) Van der waals' forces
(c) Hydrogen bond formation
(d) Covalent attraction

12. In XeF_2, XeF_4 and XeF_6, the number of lonepairson Xe are respectively
(a) 2, 3, 1 (b) 1, 2, 3
(c) 4, 1, 2 (d) 3, 2, 1

13. The hybridization of atomic orbitals of nitrogen in NO_2^+, NO_2^- and NH_4^+ are
(a) sp^2, sp^3 and sp^2 respectively
(b) sp, sp^2 and sp^3 respectively
(c) sp^2, sp and sp^3 respectively
(d) sp^2, sp^3 and sp respectively

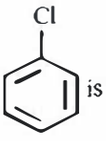
14. Match Column-I with Column-II and Column-III and choose the correct option from the given codes.

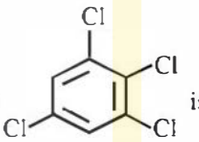
Column-I Molecule	Column-II (No. of lone pairs and bond pairs)	Column-III (Shape of molecule)
(A) NH_3	(i) 1, 2	(p) Bent
(B) SO_2	(ii) 1, 4	(q) Trigonal pyramidal
(C) SF_4	(iii) 2, 3	(r) T-shape
(D) ClF_3	(iv) 1, 3	(s) See-Saw

(a) A – (iv, q); B – (ii, p); C – (i, r); D – (iii, s)
(b) A – (iv, q); B – (i, p); C – (ii, s); D – (iii, r)
(c) A – (i, p); B – (iii, s); C – (iv, r); D – (ii, q)
(d) A – (iv, p); B – (i, r); C – (iii, q); D – (ii, s)

15. Which of the following statements is/are not correct for combination of atomic orbitals?
(i) The combining atomic orbitals must have the same or nearly the same energy.
(ii) Greater the extent of overlap, the greater will be the electron density between the nuclei of a molecular orbital.
(iii) $2p_x$ orbital of one atom can combine with either of $2p_x$, $2p_y$ or $2p_z$ orbital of other atom as these orbitals have same energy.
(a) (i) and (ii) (b) (iii) only
(c) (i) only (d) (ii) and (iii)

16. Which of the following is the correct increasing order of lone pair of electronson the central atom?
(a) $IF_7 < IF_5 < ClF_3 < XeF_2$
(b) $IF_7 < XeF_2 < ClF_2 < IF_5$
(c) $IF_7 < ClF_3 < XeF_2 < IF_5$
(d) $IF_7 < XeF_2 < IF_5 < ClF_3$

17. The dipole moment of chlorobenzene  is 1.5 D.

The dipole moment of  is
(a) 2.86D (b) 2.25D
(c) 1.5D (d) 0D

18. In compounds of type ECl_3, where E = B, P, As or Bi, the angles Cl - E- Cl for different E are in the order.
(a) B > P = As = Bi (b) B > P > As > Bi
(c) B < P = As = Bi (d) B < P < As < Bi

19. Which of the following substances has the greatest ionic character ?
(a) Cl_2O (b) NCl_3
(c) $PbCl_2$ (d) $BaCl_2$

RESPONSE GRID					
	8. ⓐⓑⓒⓓ	**9.** ⓐⓑⓒⓓ	**10.** ⓐⓑⓒⓓ	**11.** ⓐⓑⓒⓓ	**12.** ⓐⓑⓒⓓ
	13. ⓐⓑⓒⓓ	**14.** ⓐⓑⓒⓓ	**15.** ⓐⓑⓒⓓ	**16.** ⓐⓑⓒⓓ	**17.** ⓐⓑⓒⓓ
	18. ⓐⓑⓒⓓ	**19.** ⓐⓑⓒⓓ			

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20. If an organic compound contain 92.3% C and 7.7% H, then number of sp^3,sp^2 and sp hybridized carbon atoms in all possible structures of compound respectively are (molecular mass = 52 g/mol)
(a) 1,2,5 (b) 0,4,4
(c) 0,8,4 (d) None of these

21. Which of the following are isoelectronic and isostructural?
$NO_3^-, CO_3^{2-}, ClO_3^-, SO_3$
(a) NO_3^-, CO_3^{2-} (b) SO_3, NO_3^-
(c) ClO_3^-, CO_3^{2-} (d) CO_3^{2-}, SO_3

22. Consider the chemical species NO_3^-, NO_2^+ and NO_2^- and point out the correct statement given below
(a) The hybrid state of N in NO_2^+ is sp^2
(b) The hybrid state of N in all the species is the same
(c) The shape of both NO_2^+ and NO_2^- is bent while NO_3^- is planar
(d) The hybrid state of N in NO_3^- and NO_2^- is the same

23. Bond order normally gives idea of stability of a molecular species. All the molecules viz. H_2, Li_2 and B_2 have the same bond order yet they are not equally stable. Their stability order is
(a) $H_2 > B_2 > Li_2$ (b) $Li_2 > H_2 > B_2$
(c) $Li_2 > B_2 > H_2$ (d) $H_2 > Li_2 > B_2$

24. $_1H^2 + {}_1H^2 \longrightarrow {}_2He^3 + {}_0n^1$
The above nuclear reaction is called
(a) nuclear fission
(b) nuclear fusion
(c) artificial transmutation
(d) spontaneous disintegration

25. Hydrogen chloride molecule contains
(a) polar covalent bond (b) double bond
(c) co-ordinate bond (d) electrovalent bond

26. Among the following species, identify the isostructural pairs
$NF_3, NO_3^-, BF_3, H_3O^+, HN_3$
(a) $[NF_3, NO_3^-]$ and $[BF_3, H_3O^+]$
(b) $[NF_3, HN_3]$ and $[NO_3^-, BF_3]$
(c) $[NF_3, H_3O^+]$ and $[NO_3^-, BF_3]$
(d) $[NF_3, H_3O^+]$ and $[HN_3, BF_3]$

27. In the anion $HCOO^-$ the two carbon - oxygen bonds are found to be of equal length. What is the reason for it ?
(a) Electronic orbitals of carbon atom are hybridised
(b) The C = O bond is weaker than the C –O bond
(c) The anion $HCOO^-$ has two resonating structures
(d) The anion is obtained by removal of a proton from the acid molecule

28. Which of the following is/are not essential condition(s) for hybridisation?
(i) The orbitals present in the valence shell of the atom are hybridised.
(ii) The orbitals undergoing hybridisation should have almost equal energy.
(iii) Promotion of electron is essential prior to hybridisation
(iv) Only half filled orbitals participate in hybridisation.
(a) (i) only (b) (iii) only
(c) (iv) only (d) (iii) and (iv)

29. The molecule XY_2 contains two σ and two π bonds and one lone pair of electrons in valence shell of X. The arrangement of lone pair and bond pairs is
(a) linear (b) trigonal planar
(c) square pyramidal (d) unpredictable

30. The molecules BF_3 and NF_3 are both covalent compounds, but BF_3 is non polar whereas NF_3 is polar. The reason for this is
(a) atomic size of boron is larger than nitrogen
(b) Boron is metal while nitrogen is gas
(c) B – F bonds are non-polar while N – F bonds are polar
(d) BF_3 is planar but NF_3 is pyramidal

31. Amongst LiCl, RbCl, $BeCl_2$ and $MgCl_2$ the compounds with the greatest and the least ionic character, respectively are:
(a) LiCl and RbCl (b) RbCl and $BeCl_2$
(c) $MgCl_2$ and $BeCl_2$ (d) RbCl and $MgCl_2$

32. Which of the following is the wrong statement ?
(a) ONCl and ONO^- are not isoelectronic.
(b) O_3 molecule is bent
(c) Ozone is violet-black in solid state
(d) Ozone is paramagnetic gas.

RESPONSE GRID					
	20. ⓐⓑⓒⓓ	**21.** ⓐⓑⓒⓓ	**22.** ⓐⓑⓒⓓ	**23.** ⓐⓑⓒⓓ	**24.** ⓐⓑⓒⓓ
	25. ⓐⓑⓒⓓ	**26.** ⓐⓑⓒⓓ	**27.** ⓐⓑⓒⓓ	**28.** ⓐⓑⓒⓓ	**29.** ⓐⓑⓒⓓ
	30. ⓐⓑⓒⓓ	**31.** ⓐⓑⓒⓓ	**32.** ⓐⓑⓒⓓ		

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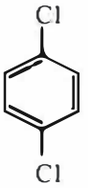
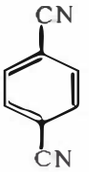
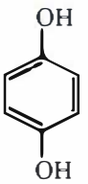
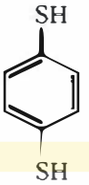
33. For which of the following molecule significant $\mu \neq 0$?

(i) 

(ii) 

(iii) 

(iv) 

(a) Only(i) (b) (i) and (ii)
(c) Only(iii) (d) (iii) and (iv)

34. The bond dissociation energy of B – F in BF_3 is 646 kJ mol^{-1} whereas that of C – F in CF_4 is 515 kJ mol^{-1}. The correct reason for higher B – F bond dissociation energy as compared to that of C – F is
(a) stronger σ bond between B and F in BF_3 as compared to that between C and F in CF_4.
(b) significant $p\pi - p\pi$ interaction between B and F in BF_3 whereas there is no possibility of such interaction between C and F in CF_4.
(c) lower degree of $p\pi - p\pi$ interaction between B and F in BF_3 than that between C and F in CF_4.
(d) smaller size of B–atom as compared to that of C–atom.

35. Dipole-induced dipole interactions are present in which of the following pairs :
(a) Cl_2 and CCl_4 (b) HCl and He atoms
(c) SiF_4 and He atoms (d) H_2O and alcohol

36. The number and type of bonds in C_2^{2-} ion in CaC_2 are:
(a) One σ bond and one π-bond
(b) One σ bond and two π-bond
(c) Two σ bond and two π-bond
(d) Two σ bond and one π-bond

37. Which of the following methods is used for measuring bond length ?
(a) X-ray diffraction
(b) Electron-diffraction
(c) Spectroscopic techniques
(d) All of these

38. Which of the following molecules have same bond order ?

$\underset{I}{H_2}, \underset{II}{Cl_2}, \underset{III}{CO}, \underset{IV}{Br_2}, \underset{V}{N_2}$

Choose the correct option.
(a) I, II and IV have same bond order
(b) III and V have same bond order
(c) Both (a) and (b) are correct
(d) None of the above

39. Which of the following is/are misconception(s) associated with resonance ?
(i) The molecule exists for a certain fraction of time in one cannonical form and for other fractions of time in other cannonical forms.
(ii) The cannonical forms have no real existence.
(iii) There is no such equilibrium between the cannonical forms.
(a) (i) only (b) (ii) and (iii)
(c) (i) and (iii) (d) (iii) only.

40. A neutral molecule XF_3 has a zero dipole moment. The element X is most likely
(a) chlorine (b) boron
(c) nitrogen (d) carbon

41. The species having pyramidal shape is :
(a) SO_3 (b) BrF_3 (c) SiO_3^{2-} (d) OSF_2

42. Bond order of 1.5 is shown by:
(a) O_2^+ (b) O_2^- (c) O_2^{2-} (d) O_2

43. Which one of the following properties is **not** shown by NO?
(a) It is diamagnetic in gaseous state
(b) It is neutral oxide
(c) It combines with oxygen to form nitrogen dioxide
(d) It's bond order is 2.5

44. The charge/size ratio of a cation determines its polarizing power. Which one of the following sequences represents the increasing order of the polarizing power of the cationic species, K^+, Ca^{2+}, Mg^{2+}, Be^{2+}?
(a) $Ca^{2+} < Mg^{2+} < Be^{+} < K^+$
(b) $Mg^{2+} < Be^{2+} < K^+ < Ca^{2+}$
(c) $Be^{2+} < K^+ < Ca^{2+} < Mg^{2+}$
(d) $K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$.

45. In which of the following pairs of molecules/ions, both the species are not likely to exist ?
(a) H_2^+, He_2^{2-} (b) H_2^-, He_2^{2-}
(c) H_2^{2+}, He_2 (d) H_2^-, He_2^{2+}

RESPONSE GRID					
	33. (a)(b)(c)(d)	**34.** (a)(b)(c)(d)	**35.** (a)(b)(c)(d)	**36.** (a)(b)(c)(d)	**37.** (a)(b)(c)(d)
	38. (a)(b)(c)(d)	**39.** (a)(b)(c)(d)	**40.** (a)(b)(c)(d)	**41.** (a)(b)(c)(d)	**42.** (a)(b)(c)(d)
	43. (a)(b)(c)(d)	**44.** (a)(b)(c)(d)	**45.** (a)(b)(c)(d)		

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