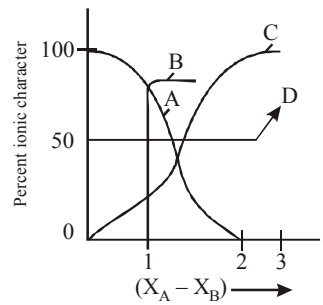
4

CHEMICAL BONDING AND MOLECULAR STRUCTURE

MCQs with One Correct Answer

1. For AB bond if percent ionic character is plotted against electronegativity difference $(X_A - X_B)$, the shape of the curve would look like



The correct curve is

(a) (A) (b) (B)

(c) (C) (d) (D)

2. The electronegativity difference between N and F is greater than that between N and H yet the dipole moment of NH_3 (1.5 D) is larger than that of NF_3 (0.2D). This is because

(a) in NH_3 the atomic dipole and bond dipole are in the same direction whereas in NF_3 these are in opposite directions

(b) in NH_3 as well as NF_3 the atomic dipole and bond dipole are in opposite directions

(c) in NH_3 the atomic dipole and bond dipole are in the opposite directions whereas in NF_3 these are in the same direction

(d) in NH_3 as well as in NF_3 the atomic dipole and bond dipole are in the same direction

3. Among the following, the species with identical bond order are

(a) CO and O_2^{2-}

(b) O_2^- and CO

(c) O_2^{2-} and B_2

(d) CO and N_2^+

4. Which of the following statements is/are true

1. PH_5 and $BiCl_5$ do not exist
2. $p\pi - d\pi$ bond is present in SO_2
3. I_3^+ has bent geometry
4. SeF_4 and CH_4 have same shape

(a) 1, 2, 3 (b) 1, 3

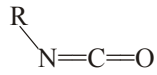
(c) 1, 3, 4 (d) 1, 2, 4

5. The number of sigma (σ) and pi (π) bonds present in 1,3,5,7 octatetraene respectively are

(a) 14 and 3 (b) 17 and 4

(c) 16 and 5 (d) 15 and 4

6. The hybridizations of N, C and O shown in the following compound



respectively, are

(a) sp^2, sp, sp^2 (b) sp^2, sp^2, sp^2

(c) sp^2, sp, sp (d) sp, sp, sp^2

7. 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.

8. The most polarizable ion among the following is

(a) F^- (b) I^-

(c) Na^+ (d) Cl^-

9. Minimum $F-S-F$ bond angle present in :

(a) SSF_2 (b) SF_6

(c) SF_2 (d) F_3SSF

10. Which of the following statement is correct about I_3^+ and I_3^- molecular ions?

(a) Number of lone pairs at central atoms are same in both molecular ions

(b) Hybridization of central atoms in both ions are same

(c) Both are polar species

(d) Both are planar species

11. In which of the following species, *d*-orbitals having *xz* and *yz* two nodal planes involved in hybridization of central atom?

(a) $IO_2F^-_2$

(b) ClF^-_4

(c) IF_7

(d) None of these

12. The type of bonds present in sulphuric anhydride is,

(a) 3σ and three $p\pi - d\pi$

(b) 3σ, one $p\pi - p\pi$ and two $p\pi - d\pi$

(c) 2σ and three $p\pi - d\pi$

(d) 2σ and two $p\pi - d\pi$

13. The correct statement with regard to H_2^+ and H_2^- is

(a) Both H_2^+ and H_2^- do not exist

(b) H_2^- is more stable than H_2^+

(c) H_2^+ is more stable than H_2^-

(d) Both H_2^+ and H_2^- are equally stable

14. The correct order of bond energies in NO, NO^+ and NO^- is:

(a) $NO^- > NO > NO^+$

(b) $NO > NO^- > NO^+$

(c) $NO^+ > NO > NO^-$

(d) $NO^+ > NO^- > NO$

15. Which of the following represents the correct order of Cl–O bond lengths in $ClO^-, ClO_2^-, ClO_3^-, ClO_4^-$?

(a) $ClO_4^- = ClO_3^- = ClO_2^- = ClO^-$

(b) $ClO^- < ClO_2^- < ClO_3^- < ClO_4^-$

(c) $ClO_4^- < ClO_3^- < ClO_2^- < ClO^-$

(d) $ClO_3^- < ClO_4^- < ClO_2^- < ClO^-$

16. Which one of the following molecule will have all equal X—F bond length? (where X = Central atom)

(a) $SOCl_2F_2$ (b) SeF_4

(c) PBr_2F_3 (d) IF_7

17. 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 less than that of in N_2H_4

(a) I, II and III

(b) I and III

(c) II and IV

(d) II and III

18. The correct order of 'S—O' bond length is

(a) $SO_3^{2-} > SO_4^{2-} > SO_3 > SO_2$

(b) $SO_3^{2-} > SO_4^{2-} > SO_2 > SO_3$

(c) $SO_4^{2-} > SO_4^{2-} > SO_2 > SO_3$

(d) $SO_4^{2-} > SO_4^{2-} > SO_3 > SO_2$

19. Among the following transformations, the hybridization of the central atom remains unchanged in

(a) $CO_2 \rightarrow HCOOH$

(b) $BF_3 \rightarrow BF_4^-$

(c) $NH_3 \rightarrow NH_4^+$

(d) $PCl_3 \rightarrow PCl_5$

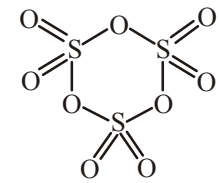
20. In which species, X—O bond order is 1.5 and contains $p\pi - d\pi$ bond(s).

(a) $IO_2F^-_2$ (b) $HCOO^-$

(c) SO^{2-}_3 (d) XeO_2F_2

Numeric Value Answer

21. Consider the following molecule



Calculate the value of $p \div q$, here p and q are total number of $d\pi$–$p\pi$ bonds and total number of sp^3 hybridised atoms respectively in given molecule.

22. Calculate the value of "$x + y - z$" here x, y and z are total number of non-bonded electron pair(s), pie(π) bond(s) and sigma (σ) bonds in hydrogen phosphite ion respectively.

23. Total number of species which used all three *p*-orbitals in hybridisation of central atoms and should be non-polar also are

XeO_2F_2, $SnCl_2$, IF_5, I_3^+, XeO_4, SO_2, XeF_7^+, SeF_4

24. Consider the following orbitals $3s$, $2p_x$, $4d_{xy}$, $4d_z^2$, $3d_{x^2-y^2}$, $3p_y$, $4s$, $4p_z$ and find total number of orbital(s) having even number of nodal plane.

25. For the following molecules :

PCl_5, BrF_3, ICl_2^-, XeF_5^-, NO_3^-, XeO_2F_2, PCl_4^+, CH_3^+

Calculate the value of $\dfrac{a+b}{c}$

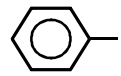
a = Number of species having sp^3 *d*-hybridisation

b = Number of species which are planar

c = Number of species which are non-planar

26. Find total number of orbital which can overlap colaterally, (if inter nuclear axis is z) s, p_x, p_y, p_z, d_{xy}, d_{yz}, d_{xz}, d_{z^2}, $d_{x^2-y^2}$

27. In O_2^- , O_2 and O_2^{2-} molecular species, the sum of the total number of antibonding electrons is _____

28. Dipole moment of  X is 1.6 D. What is the dipole moment of following compound:

29. What is the % of *p*-character with central atom in SF_6 molecule?

30. Consider the following values for an ionic compound NaCl.

$\Delta H_f(NaCl) = -200$ KJ/mol

$\Delta H_{sub}(Na(s)) = 650$ KJ/mol

$\Delta H_{diss}(Cl_2(g)) = 400$ KJ/mol

$I.E._1(Na(g)) = 500$ KJ/mol

Electron gain enthalpy $(Cl(g)) = -350$ KJ/mol

Using Born Haber Cycle, find the value of lattic energy (U) in KJ/mol.

ANSWER KEY																			
1	(c)	**4**	(a)	**7**	(b)	**10**	(d)	**13**	(c)	**16**	(a)	**19**	(c)	**22**	(3)	**25**	(3)	**28**	(1.6)
2	(a)	**5**	(b)	**8**	(b)	**11**	(c)	**14**	(c)	**17**	(b)	**20**	(a)	**23**	(2)	**26**	(6)	**29**	(50)
3	(c)	**6**	(a)	**9**	(d)	**12**	(b)	**15**	(c)	**18**	(b)	**21**	(1)	**24**	(5)	**27**	(21)	**30**	(1200)