

I. Choose the correct answers.**PART -A****(15X 1 = 15)**

1. Isostructural species are those which have the same shape and hybridisation.

Among the given species identify the isostructural pairs.

- (i) $[\text{NF}_3 \text{ and } \text{BF}_3]$
- (ii) $[\text{BF}_4^- \text{ and } \text{NH}_4^+]$
- (iii) $[\text{BCl}_3 \text{ and } \text{BrCl}_3]$
- (iv) $[\text{NH}_3 \text{ and } \text{NO}_3^-]$

2. Assertion (A) : Though the central atom of both NH_3 and H_2O molecules are sp^3 hybridised, yet $\text{H}-\text{N}-\text{H}$ bond angle is greater than that of $\text{H}-\text{O}-\text{H}$.

Reason (R) : This is because nitrogen atom has one lone pair and oxygen atom has two lone pairs.

- (i) A and R both are correct, and R is the correct explanation of A.
- (ii) A and R both are correct, but R is not the correct explanation of A.
- (iii) A is true but R is false.
- (iv) A and R both are false.

3. The types of hybrid orbitals of nitrogen in NO_2^+ , NO_3^- and NH_4^+ respectively are expected to be

- (i) sp , sp^3 and sp^2
- (ii) sp , sp^2 and sp^3
- (iii) sp^2 , sp and sp^3
- (iv) sp^2 , sp^3 and sp

4. Hydrogen bonds are formed in many compounds e.g., H_2O , HF , NH_3 . The boiling point of such compounds depends to a large extent on the strength of hydrogen bond and the number of hydrogen bonds. The correct decreasing order of the boiling points of above compounds is :

- (i) $\text{HF} > \text{H}_2\text{O} > \text{NH}_3$
- (ii) $\text{H}_2\text{O} > \text{HF} > \text{NH}_3$
- (iii) $\text{NH}_3 > \text{HF} > \text{H}_2\text{O}$
- (iv) $\text{NH}_3 > \text{H}_2\text{O} > \text{HF}$

5. In PO_4^{3-} ion the formal charge on the oxygen atom of P-O bond is

- (i) + 1
- (ii) - 1
- (iii) - 0.75
- (iv) + 0.75

6. In NO_3^- ion, the number of bond pairs and lone pairs of electrons on nitrogen atom are

- (i) 2, 2
- (ii) 3, 1
- (iii) 1, 3
- (iv) 4, 0

7. Which of the following species has tetrahedral geometry?

- (i) BH_4^-
- (ii) NH_2^-
- (iii) CO_3^{2-}
- (iv) H_3O^+

8. Which of the following pair is expected to have the same bond order?

- (i) O_2 , N_2
- (ii) O_2^+ , N_2^-
- (iii) O_2^- , N_2^+
- (iv) O_2^- , N_2^-

9. In which of the following molecules, σ_{2p_z} molecular orbital is filled after n_{2p_x} and n_{2p_y} molecular orbitals?

- (i) O_2
- (ii) Ne_2
- (iii) N_2
- (iv) F_2

10. In which of the following molecule/ion all the bonds are not equal?

- (i) XeF_4
- (ii) BF_4^-
- (iii) C_2H_4
- (iv) SiF_4

11. In which of the following substances will hydrogen bond be strongest?

- (i) HCl
- (ii) H_2O
- (iii) HI
- (iv) H_2S

12. If the electronic configuration of an element is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$, the four electrons involved in chemical bond formation will be_____.

- (i) $3p^6$
- (ii) $3p^6, 4s^2$
- (iii) $3p^6, 3d^2$
- (iv) $3d^2, 4s^2$

13. Which of the following angle corresponds to sp^2 hybridisation?

- (i) 90°
- (ii) 120°
- (iii) 180°
- (iv) 109°

14. The number of dative bonds in sulphuric acid is ---- ◦ (i) 0 ◦ (ii) 1 ◦ (iii) 2 ◦ (iv) 4

15. The compound containing co-ordinate bond is--- ◦ (i) O_3 ◦ (ii) SO_3 ◦ (iii) H_2SO_4 ◦ (iv) All of these

PART-B

II. Answer any six Questions, but question number 20 is compulsory.

(6 X 2 = 12)

16. Arrange the bonds in order of increasing ionic character in LiF, K₂O, N₂, SO₂ and ClF₃
17. Predict the shapes of the ions (a) BeF₃⁻ (b) BF₄⁻ (c) IF₄⁻ (d) IBr₂⁻
18. Arrange the following in increasing order of stability O₂, O₂⁺, O₂⁻, O₂²⁻
19. Write down the resonance structure of nitrous oxide?
20. Out of the three molecules XeF₄, SF₄ and SiF₄ which one has tetrahedral structure?
21. What is the bond order of C₂?
22. Distinguish between a sigma and a pi bond.
23. Explain the structure of CO₃²⁻ ion in terms of resonance.
24. AlF₃ is ionic while AlCl₃ is covalent. Why?

PART-C

III. Answer any six Questions, but question number 29 is compulsory.

(6 X 3 = 18)

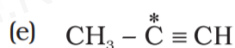
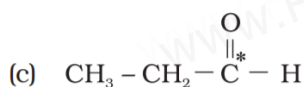
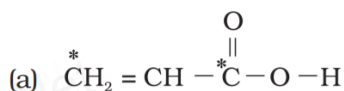
25. Why bond angle in NH₃ is 107° while in H₂O it is 104.5°?
26. Predict the hybridization for the central atom in POCl₃, OSF₄ and OIF₅.
27. Define octet rule. Write its significance and limitations.
28. Discuss the shape of the molecules using the VSEPR model: BeCl₂, BCl₃, SiCl₄, AsF₅, H₂S and PH₃
29. What is the total number of sigma and pi bonds in the molecules? (a) C₂H₂ (b) C₂H₄
30. Use molecular orbital theory to explain why the He₂ molecule does not exist.
31. Which out of NH₃ and NF₃ has higher dipole moment and why?
32. Draw MO diagram of CO and calculate its bond order.
33. Which bond is stronger σ or π? Why?

PART - D

IV. Answer all the five questions

(5 X 5 = 25)

34. a). Use the molecular orbital energy level diagram to show that N₂ would be expected to have a triple bond, F₂, a single bond and Ne₂, no bond. (OR)
- b). Discuss the concept of hybridisation. What are its different types in a carbon atom?
35. a) Describe Fajan's rule with examples. (OR)
- b) Explain VSEPR theory. Applying this theory to predict the shapes of IF₇ and SF₆
36. a) Draw the M.O diagram for O₂ molecule calculate its bond order and show that O₂ is paramagnetic. (OR)
- b) Which hybrid orbitals are used by carbon atoms in the following molecules?
a) CH₃-CH₃ b) CH₃-CH=CH₂ c) CH₃-CH₂-OH d) CH₃-CHO e) CH₃COOH
37. a) What do you understand by bond pairs and lone pairs of electrons? Illustrate by giving one example of each type. (OR)
- b) Write the important conditions required for the linear combination of atomic orbitals to form molecular orbitals.
38. i) Draw the Lewis structures for the species. a) NO₃⁻ b) SO₄²⁻ c) HNO₃ d) O₃ (OR)
- (ii) What is the type of hybridisation of carbon atoms marked with star.



ALL THE BEST