

Chemistry
Higher level
Paper 1A

Practice paper

Topic: Chemical Bonding & Structure (Topic 4 & 14)

1. Which molecule contains an expanded octet?
 - A. CH_4
 - B. PCl_5
 - C. NH_3
 - D. BF_3

2. What is the molecular geometry of the SF_4 molecule?
 - A. Tetrahedral
 - B. See-saw
 - C. Square planar
 - D. Trigonal bipyramidal

3. Which species contains a central atom with sp^2 hybridization?
 - A. CH_4
 - B. BF_3
 - C. C_2H_2
 - D. H_2O

4. Which statements about the resonance hybrid of the carbonate ion, CO_3^{2-} , are correct?
 - I. All C-O bond lengths are identical.
 - II. Each C-O bond order is 1.33.
 - III. The central carbon atom is sp^2 hybridized.
 - A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

5. How many sigma (sigma) and pi (pi) bonds are present in a molecule of ethyne (C_2H_2)?
 - A. 2 sigma, 1 pi
 - B. 3 sigma, 1 pi
 - C. 3 sigma, 2 pi
 - D. 2 sigma, 2 pi

6. Which value represents the formal charge on the Nitrogen atom in the Ammonium ion (NH_4^+)?
 - A. 0
 - B. +1
 - C. -1

D. +4

7. In the ozone molecule (O_3), what is the average bond order for the O-O bonds?

- A. 1
- B. 1.5
- C. 2
- D. 3

8. Which of the following molecules exhibit an expanded octet on the central atom?

- I. SF_6
 - II. PCl_5
 - III. BF_3
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

9. Which of the following has a square planar molecular geometry?

- A. XeF_4
- B. SF_4
- C. CF_4
- D. PCl_4^+

10. Which orbital overlap correctly represents a pi (π) bond?

- A. Head-on overlap of s orbitals
- B. Head-on overlap of p orbitals
- C. Side-on overlap of p orbitals
- D. Head-on overlap of hybrid orbitals

11. What is the hybridization of carbon in the carbonate ion (CO_3^{2-})?

- A. sp
- B. sp^2
- C. sp^3
- D. sp^3d

12. Which factors affect the magnitude of the lattice enthalpy in ionic compounds?

- I. The size of the ions
 - II. The charge on the ions
 - III. The electronegativity difference between the atoms
- A. I and II only

- B. I and III only
- C. II and III only
- D. I, II and III

13. Which molecule is non-polar despite having expanded octet central atoms?

- A. ClF_3
- B. PCl_5
- C. SF_4
- D. BrF_5

14. What is the formal charge on the Oxygen atom in the CO molecule?

- A. 0
- B. +1
- C. -1
- D. -2

15. Which molecule contains a coordinate bond where Nitrogen donates both electrons?

- A. NH_3
- B. NH_4^+
- C. N_2
- D. NO_2

16. Which types of overlap can result in the formation of a pi (π) bond?

- I. Side-on overlap of p orbitals
 - II. Side-on overlap of d orbitals
 - III. Head-on overlap of s orbitals
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

17. Which of the following has a bond angle of approximately 107 degrees?

- A. PCl_3
- B. BF_3
- C. CH_4
- D. SF_6

18. Which statement about delocalization is correct?

- A. Electrons are localized between two atoms.
- B. It decreases the stability of a molecule.

- C. It leads to bond lengths that are intermediate between single and double bonds.
- D. It only occurs in ionic compounds.

19. What is the hybridization of the oxygen atom in H_2O ?
- A. sp
 - B. sp^2
 - C. sp^3
 - D. Unhybridized
20. Which properties are characteristic of giant covalent structures like diamond?
- I. High melting and boiling points
 - II. Poor electrical conductivity in the solid state
 - III. Solubility in polar solvents
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III
21. Which molecule has a T-shaped geometry?
- A. BF_3
 - B. NH_3
 - C. ClF_3
 - D. XeF_2
22. How many electron domains are around the central atom in BrF_5 ?
- A. 4
 - B. 5
 - C. 6
 - D. 7
23. Which explains why graphite conducts electricity but diamond does not?
- A. Graphite has sp^3 hybridization.
 - B. Graphite has a pi-delocalized electron system.
 - C. Diamond has layers that can slide.
 - D. Diamond is ionic.
24. Which statements correctly describe the bonding in benzene, C_6H_6 ?
- I. The carbon atoms are sp^2 hybridized.
 - II. The pi electron system is delocalized above and below the ring.
 - III. It contains three distinct $\text{C}=\text{C}$ double bonds.

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

25. What is the molecular shape of the I_3^- ion?

- A. Bent
- B. Trigonal planar
- C. Linear
- D. T-shaped

26. Which bond is the strongest among the following Carbon-Carbon bonds?

- A. C-C in ethane
- B. C=C in ethene
- C. C triple bond C in ethyne
- D. C-C in benzene

27. What is the hybridization of Nitrogen in N_2H_4 ?

- A. sp
- B. sp^2
- C. sp^3
- D. sp^2d

28. Which of the following species have a square planar molecular geometry?

- I. XeF_4
 - II. $[\text{PtCl}_4]^{2-}$
 - III. $[\text{Ni}(\text{CN})_4]^{2-}$
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

29. Which describes the formation of a sigma (sigma) bond?

- A. Side-on p-p overlap.
- B. Head-on s-s overlap only.
- C. Head-on overlap of any atomic or hybrid orbitals.
- D. Overlap of d orbitals with s orbitals.

What is the shape of the IF_4^- ion?

- A. Tetrahedral

- B. Square planar
- C. See-saw
- D. Square pyramidal

Which set of species contains a delocalized pi electron system?

- A. CO_3^{2-} , O_3 , SO_2
- B. CH_4 , NH_3 , H_2O
- C. C_2H_4 , C_2H_2 , C_2H_6
- D. SO_4^{2-} , PO_4^{3-} , SiO_4^{4-}

32. Which overlap combinations lead to a sigma (sigma) bond?

- I. s-s overlap
 - II. s-p overlap
 - III. p-p head-on overlap
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

The hybridization of the central atom changes from sp^2 to sp^3 in which reaction?

- A. $\text{NH}_3 + \text{H}^+ \rightarrow \text{NH}_4^+$
- B. $\text{C}_2\text{H}_4 + \text{H}_2 \rightarrow \text{C}_2\text{H}_6$
- C. $\text{C}_2\text{H}_2 + 2\text{H}_2 \rightarrow \text{C}_2\text{H}_6$
- D. $\text{BF}_3 + \text{F}^- \rightarrow \text{BF}_4^-$

Which molecule contains a central atom with sp^3d^2 hybridization?

- A. SF_6
- B. PCl_5
- C. SF_4
- D. XeF_2

Which noble gas compound has a linear molecular geometry?

- A. XeF_4
- B. XeO_3
- C. XeF_2
- D. KrF_4

Which statements correctly describe the bonding in silicon dioxide (SiO_2)?

- I. Every silicon atom is covalently bonded to four oxygen atoms.
- II. The structure contains pi (pi) double bonds.

III. It forms a giant macromolecular lattice.

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

What determines the covalent character of an ionic bond?

- A. High polarization of a large anion by a small, highly charged cation.
- B. Low electronegativity difference between identical atoms.
- C. Head-on overlap of s and p atomic orbitals.
- D. Delocalization of valence electrons over a metal lattice.

Which species does not obey the octet rule?

- A. PCl_3
- B. CO_2
- C. NO_2
- D. NH_3

What causes the relatively high boiling point of hydrogen fluoride compared to other hydrogen halides?

- A. Giant covalent structure
- B. Hydrogen bonding
- C. Strong covalent intramolecular bonds
- D. Extensive London dispersion forces

Which conditions favor the formation of an ionic bond?

- I. Low ionization energy of the metal
 - II. High electron affinity of the non-metal
 - III. Large difference in electronegativity
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III