

PADMA CHEMISTRY CLASSES

CHEMICAL BONDING

VSEPR , VBT , HYBRIDIZATION

Pratice

PROBLEMS

IIT JEE & NEET

**CONTACT US:
PADMA CHEMISTRY CLASSES
AT +91 93029-04118**

MAIL US AT:-
info@padmaclasses.com
FOR MORE DETAILS VISIT:-
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VSEPR, VBT & Hybridisation

Level 1

- Which of the following has maximum bond angle ?
 - H₂O
 - NH₃
 - CO₂
 - CH₄
- The shape of ClO₃⁻ according to VSEPR model is
 - planar triangle
 - pyramidal
 - tetrahedral
 - square planar
- CO₂ is isostructural with:-
 - CH₄
 - SnCl₂
 - HgCl₂
 - H₂O
- The hybridization of carbon atoms in alkene, C₃H₄ is
 - sp², sp², sp²
 - sp², sp, sp²
 - sp, sp², sp
 - sp, sp³, sp
- The bond angle in OF₂, OCl₂ and OBr₂ show the order
 - OF₂ > OCl₂ > OBr₂
 - OF₂ > OBr₂ > OCl₂
 - OBr₂ > OCl₂ > OF₂
 - OCl₂ > OBr₂ > OF₂
- The number and type of bonds between two carbon atoms in CaC₂ are
 - One σ and one π-bond
 - One σ and two π-bond
 - One σ and one-half π-bond
 - One σ bond
- Which of the following is a planar molecule?
 - NH₃
 - H₃O⁺
 - BCl₃
 - PCl₃
- d²sp³ hybridization of atomic orbitals gives
 - square planar structure
 - triangular structure
 - tetrahedral structure
 - octahedral structure
- Atomic orbitals of carbon in graphite have
 - sp hybridization
 - sp² hybridization
 - sp³ hybridization
 - dsp² hybridization

10. An sp^3 hybrid orbital contains

- a. $\frac{1}{4}$ s-character b. $\frac{1}{2}$ s-character
c. $\frac{2}{3}$ s-character d. $\frac{3}{2}$ s-character

11. Select the molecule which has only one π -bond

- a. $CH \equiv CH$ b. $CH_2 = CH - CHO$
c. $CH_3 - CH = CH_2$ d. $CH_3 - CH = CH - COOH$

12. Which of the following species has a trigonal planer shape?

- a. $:CH_3^-$ b. CH_3^+
c. BF_4^- d. SiH_4

13. Match the following :

	Column I		Column II
A	Ethane	p	$2sp$ carbons
B	Ethylene	q	$6sp^2$ carbons
C	Acetylene	r	$2sp^3$ carbons
D	Benzene	s	$2sp^2$ carbons

The correct answer is

- a. $A \rightarrow r ; B \rightarrow s ; C \rightarrow p ; D \rightarrow q$
b. $A \rightarrow p ; B \rightarrow q ; C \rightarrow r ; D \rightarrow s$
c. $A \rightarrow q ; B \rightarrow p ; C \rightarrow s ; D \rightarrow r$
d. $A \rightarrow s ; B \rightarrow r ; C \rightarrow q ; D \rightarrow p$

14. The ratio of π and σ bonds in benzene is

- a. 1 : 2 b. 1 : 4
c. 1 : 6 d. 1 : 3

15. Which of the following have identical bond order?

- I. CN^- II. O_2^- III. NO^+ IV. CN^+
a. I, III b. I, II
c. II, IV d. I, II, III

16. When two AO's combine, energy of bonding MO is lowered by x while that of antibonding MO is raised by. Then,

- a. $x > y$ b. $x < y$
c. $x = y$ d. can be any of these

17. Which of the following is not diamagnetic?

- a. O_2^{2-} b. Li_2
c. N_2^+ d. C_2

18. The pair of species with the same bond order is

- a. O_2^{2-} , B_2 b. O_2^+ , NO^+
 c. NO , CO d. N_2 , O_2

19. Using MO theory predict which of these atom to form a σ bond with other oxygen atom in O_2 molecule?

- a. Pure p-orbital b. sp-hybrid orbital
 c. sp^2 -hybrid orbital d. sp^3 -hybrid orbital

20. Using MO theory predict which of these species has the shortest bond length?

- a. O_2^+ b. O_2^{2-}
 c. O_2^- d. O_2^{2+}

21. The bond order in NO is 2.5 while that in NO^+ is 3. Then

- a. bond length in $NO >$ in NO^+
 b. bond length in $NO^+ =$ in NO
 c. bond length in $NO^+ >$ in NO
 d. bond length is unpredictable

22. Bond order of nitric oxide is

- a. 1 b. 2.5 c. 2 d. 1.5

23. Match the following :

Column I (Species)

Column II (Bond order)

A	O_2^{2+}	p	1.0
B	O_2	q	2.0
C	F_2	r	2.5
D	O_2^+	s	3.0

- a. $A \rightarrow s$; $B \rightarrow p$; $C \rightarrow q$; $D \rightarrow r$
 b. $A \rightarrow q$; $B \rightarrow r$; $C \rightarrow p$; $D \rightarrow s$
 c. $A \rightarrow s$; $B \rightarrow q$; $C \rightarrow p$; $D \rightarrow r$
 d. $A \rightarrow r$; $B \rightarrow s$; $C \rightarrow q$; $D \rightarrow q$

24. The paramagnetic property of the oxygen molecule is due to the presence of unpaired electrons present in :

- a. $\pi^*2p_y^1$ and $\pi^*2p_x^1$ b. $\sigma 2p_z^1$ and $\pi 2p_y^1$
 c. $\pi 2p_y^1$ and $\pi^*2p_y^1$ d. $\sigma 2p_z^1$ and $\sigma^*2p_z^1$

25. Among the following compounds the one that is polar has the central atom with sp^2 -hybridisation is

- a. H_2CO_3 b. SiF_4
 c. BF_3 d. $HClO_2$

26. Match the compounds in the column I with column II.

	column I		column II.
A	XeO ₃	p	planer triangular
B	XeOF ₄	q	T-shape
C	BCl ₃	r	Trigonal pyramidal\
D	ClF ₃	s	Square pyramidal
E	I ₃ ⁻	t	Linear
		U	Bent

- a. A → r ; B → s ; C → q ; D → p ; E → t
 b. A → r ; B → s ; C → p ; D → q ; E → t
 c. A → p ; B → s ; C → r ; D → q ; E → t
 d. A → q ; B → s ; C → p ; D → r ; E → u

27. The pair of molecules in which one has linear shape while another has square pyramidal shape is

- a. Br₃⁻, PF₅ b. CO₂, NF₃
 c. SO₂, ClF₅ d. I₃⁻, BrF₅

28. The correct order of increasing s-character (in percentage) in the hybrid orbitals of following molecules/ions is :

I. CO₃²⁻ II. NCl₃ III. BeCl₂

- a. I < II < III b. II < I < III
 c. III < II < I d. III < I < II

29. Match the following and choose the correct option.

	Column I		Column II
A	BCl ₃	p	Linear
B	PdBr ₄ ²⁻	q	Planar triangular
C	SF ₆	r	Tetrahedral
D	I ₃ ⁻	s	Octahedral
		t	Square planer

- a. A → q ; B → r ; C → s ; D → p
 b. A → t ; B → r ; C → q ; D → p
 c. A → q ; B → t ; C → s ; D → p
 d. A → t ; B → s ; C → r ; D → q

30. Carbon atoms in C₂(CN)₄ are

- a. sp hybridised b. Sp² hybridised
 c. sp and sp² hybridised d. Sp, sp² and sp³ hybridised

31. The bond angle between two hybrid orbitals is 120° . The percentage of s-character of hybrid orbitals is

- a. 25% b. 50% c. 33.3% d. Cannot be predicted

32. In PO_4^{3-} the formal charge on each O-atom and P-O bond order respectively are

- a. -0.75, 1.0 b. -0.75, 1.25
c. -0.75, 0.6 d. -3, 1.25

33. Column I

- A NH_4^+ p
B H_3O^+ q
C XeO_3 r
D SO_3 s

Column II

- t
sp³ hybridisation, two lone pair
sp² hybridisation, one lone pair
sp³ hybridisation, no lone pair
sp³ hybridisation, one lone pair
sp² hybridisation, no lone pair

- a. A → p ; B → q ; C → s ; D → t
b. A → q ; B → q ; C → r ; D → t
c. A → r ; B → s ; C → s ; D → t
d. A → s ; B → s ; C → r ; D → t

34. The correct order of Cl-O bond lengths in ClO^- , ClO_2^- , ClO_3^- and ClO_4^- is

- a. $\text{ClO}^- < \text{ClO}_2^- < \text{ClO}_3^- < \text{ClO}_4^-$
b. $\text{ClO}_4^- < \text{ClO}_3^- < \text{ClO}_2^- < \text{ClO}^-$
c. $\text{ClO}_3^- < \text{ClO}_4^- < \text{ClO}_2^- < \text{ClO}^-$
d. $\text{ClO}_4^- = \text{ClO}_3^- = \text{ClO}_2^- = \text{ClO}^-$

35. In which of the following ionization processes, the bond order has increased and the magnetic behaviour has changed ?

- a. $\text{N}_2 \rightarrow \text{N}_2^+$ b. $\text{C}_2 \rightarrow \text{C}_2^+$
c. $\text{NO} \rightarrow \text{NO}^+$ d. $\text{O}_2 \rightarrow \text{O}_2^+$

36. Which facts are correctly represented?

- a. Bond length : $\text{NO}^+ < \text{NO}_2^+ < \text{NO} > \text{NO}^-$
b. Bond order : $\text{NO}^+ > \text{NO}_2^+ = \text{NO} > \text{NO}^-$
c. Bond length : $\text{NO}^+ < \text{NO}_2^+ = \text{NO} < \text{NO}^-$
d. Bond order : $\text{NO}^+ > \text{NO}_2^+ > \text{NO} > \text{NO}^-$

37. Molecular shapes of SF_4 , CF_4 and XeF_4 and the number of lone pairs on the central atom are respectively

- a. the same, with 1, 2 and 1
b. the same, with 1, 0 and 1
c. different, with 0, 1 and 2
d. different, with 1, 0 and 2

38. In which of the following molecule/ions all the bonds are not equal?

- a. SF₄ b. SiF₄
c. XeF₄ d. BF₄⁻

39. Select the correct statements among the following :

- I. Bond length in N₂⁺ is 0.02Å
II. Bond length in NO⁺ is 0.09Å
III. O₂²⁻ has a shorter bond length than O₂.
- a. I only b. II and III
c. I and II d. I, II and III

40. Among the following pairs, the one in which the two species are not isostructural is

- a. SiF₄ and SF₄ b. IO₃⁻ and XeO₃
c. BH₄⁻ and NH₄⁺ d. PF₆⁻ and SF₆

41. Among the following ions the pπ-dπ overlap could be present in

- a. NO₂⁻ b. NO₃⁻
c. PO₄³⁻ d. CO₃²⁻

42. What is the hybridization state of the central atom in the conjugate base of NH₄⁺ ion?

- a. sp b. sp² c. sp³ d. dsp²