CHEMISTRY
Chemical Bonding and Molecular Structure

1. Match List I with List II.

List I (Molecule)		List II (Number and types of bond/s between two carbon atoms)	
A.	ethane	I.	one σ –bond and two π –bonds
B.	ethene	II.	two π –bonds
C.	carbon molecule, C_2	III.	one σ –bond
D.	ethyne	IV.	one σ –bond and one π –bond

Choose the correct answer from the options given below: **(2024)**

(a) A-IV, B-III, C-II, D-I
(b) A-III, B-IV, C-II, D-I
(c) A-III, B-IV, C-I, D-II
(d) A-I, B-IV, C-II, D-III

2. Match List – I with List – II.

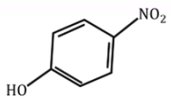
List - I (Compound)		List - II (Shape/geometry)
A.	NH_3	I. Trigonal Pyramidal
B.	BrF_5	II. Square planar
C.	XeF_4	III. Octahedral
D.	SF_6	IV. Square Pyramidal

Choose the correct answer from the options given below: **(2024)**

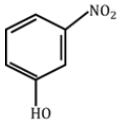
(a) A-II, B-IV, C-III, D-I
(b) A-III, B-IV, C-I, D-II
(c) A-II, B-III, C-IV, D-I
(d) A-I, B-IV, C-II, D-III

3. Intramolecular hydrogen bonding is present in **(2024)**

(a)

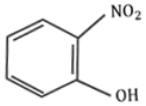


(b)



(c) HF

(d)



4. Identify the correct answer. **(2024)**

(a) BF_3 has non-zero dipole moment.
(b) Dipole moment of NF_3 is greater than that of NH_3
(c) Three canonical forms can be drawn for CO_3^{2-} ion.
(d) Three resonance structures can be drawn for ozone.

5. The correct order of dipole moments for molecules NH_3, H_2S, CH_4 and HF is: **(2023)**

(a) $CH_4 > H_2S > NH_3 > HF$
(b) $H_2S > NH_3 > HF > CH_4$
(c) $NH_3 > HF > CH_4 > H_2S$
(d) $HF > NH_3 > H_2S > CH_4$

6. Which one of the following represents all isoelectronic species? **(2023)**

(a) Na^+, Cl^-, O^-, NO^+
(b) N_2O, N_2O_4, NO^+, NO
(c) Na^+, Mg^{2+}, O^-, F^-
(d) Ca^{2+}, Ar, K^+, Cl^-

7. Which one of the following statements is incorrect related to Molecular Orbital Theory? **(2023)**

(a) The π^* antibonding molecular orbital has a node between the nuclei.
(b) In the formation of bonding molecular orbital, the two electron waves of the bonding atoms reinforce each other.
(c) Molecular orbitals obtained from $2P_x$ and $2P_y$ orbitals are symmetrical around the bond axis.
(d) A π-bonding molecular orbital has larger electron density above and below the internuclear axis.

8. Given below are two statements:

Statement I: Hydrated chlorides and bromides of Ca, Sr and Ba on heating undergo hydrolysis.

Statement II: Hydrate chlorides and bromides of Be and Mg on heating undergo dehydration.

In the light of the above statements, choose the correct answer from the options given below: **(2023)**

(a) Statement I is correct but Statement II is false.
(b) Statement II is incorrect but Statement II is true.
(c) Both Statement I and Statement II are true.
(d) Both Statement I and Statement II are false.

9. The correct order of energies of molecular orbitals of N_2 molecule, is **(2023)**

(a) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < \sigma 2p_z < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$
(b) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < \sigma 2p_z < \sigma^* 2p_z < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y)$
(c) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y) < \sigma 2p_z < \sigma^* 2p_z$
(d) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < \sigma 2p_z < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$

10. Talking stability as the factor, which one of the following represents correct relationship? **(2023)**

(a) $InI_3 > InI$
(b) $AlCl > AlCl_3$
(c) $TlI > TlI_3$
(d) $TlCl_3 > TlCl$

11. Intermolecular forces are forces of attraction and repulsion between interacting particles that will include:

A. dipole-dipole forces
B. dipole-induced dipole forces
C. hydrogen bonding
D. covalent bonding
E. dispersion forces

Choose the most appropriate answer from the options given below: **(2023)**

(a) A, B, C, D are correct
(b) A, B, C, E are correct
(c) A, C, D, E are correct
(d) B, C, D, E are correct

12. Match List I with List II:

List I (Molecules)		List II (Shape)	
A.	NH_3	i.	Square pyramidal
B.	ClF_3	ii.	Trigonal bipyramidal
C.	PCl_5	iii.	Trigonal pyramidal
D.	BrF_5	iv.	T-shape

Choose the correct answer from the options given below: **(2022)**

(a) A-iii, B-iv, C-i, D-ii
(b) A-ii, B-iii, C-iv, D-i
(c) A-iii, B-iv, C-ii, D-i
(d) A-iv, B-iii, C-i, D-ii

13. The correct order of bond angles in the following compounds/species is: **(2022)**

(a) $CO_2 < NH_3 < H_2O < \overset{+}{N}H_4$
(b) $H_2O < NH_3 < \overset{+}{N}H_4 < CO_2$
(c) $H_2O < \overset{+}{N}H_4 < NH_3 < CO_2$
(d) $H_2O < \overset{+}{N}H_4 = NH_3 < CO_2$

14. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): ICl is more reactive than I_2.

Reason (R): I-Cl bond is weaker than I-I bond.

In the light of the above statements, choose the most appropriate answer from the options given below: **(2022)**

(a) Both (A) and (R) are correct and (R) is the correct explanation of (A).
(b) Both (A) and (R) are correct but (R) is not the correct explanation of (A).
(c) (A) is correct but (R) is not correct.
(d) (A) is not correct but (R) is correct.

15. Amongst the following which one will have maximum 'lone pair – lone pair' electron repulsions? **(2022)**

(a) ClF_3
(b) IF_5
(c) SF_4
(d) XeF_2

16. Which amongst the following is incorrect statement? **(2022)**

(a) The bond orders of O_2^+, O_2, O_2^- and O_2^{2-} are 2.5, 2, 1.5 and 1, respectively

(b) C_2 molecule has four electrons in its two degenerate π molecular orbitals

(c) H_2^+ ion has one electron

(d) O_2^+ ion is diamagnetic

17. BF_3 is planar and electron compound. Hybridization and number of electrons around the **central atom**, respectively are : **(2021)**

(a) sp^3 and 6

(b) sp^2 and 6

(c) sp^2 and 8

(d) sp^3 and 4

18. Match List-I with List-II. **(2021)**

List-I		List-II	
A.	PCl_5	(i)	Square pyramidal
B.	SF_6	(ii)	Trigonal planar
C.	BrF_5	(iii)	Octahedral
D.	BF_3	(iv)	Trigonal bipyramidal

Choose the correct answer from the options given below.

(a) A-ii, B-iii, C-iv, D-i

(b) A-iii, B-I, C-iv, D-ii

(c) A-iv, B-iii, C-ii, D-i

(d) A-iv, B-iii, C-i, D-ii

19. Which of the following molecules is non-polar in nature? **(2021)**

(a) CH_2O (b) $SbCl_5$

(c) NO_2 (d) $POCl_3$

20. Which of the following set of molecules will have zero dipole moment? **(2020)**

(a) Boron trifluoride, hydrogen fluoride, carbon dioxide, 1,3-dichlorobenzene

(b) Nitrogen trifluoride, beryllium difluoride, water 1, 3-dichlorobenzzene

(c) Boron trifluoride, beryllium difluoride, carbon dioxide, 1,4-dichlorobenzene

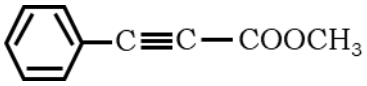
(d) Ammonia, beryllium difluoride, water, 1,4-dichlorobenzene

21. Identify a molecule which does not exist. **(2020)**

(a) Li_2 (b) C_2

(c) O_2 (d) He_2

22. How many (i) sp^2 hybridised carbon atoms and (ii) π bonds are present in the following compound? **(2020 Covid Re-NEET)**



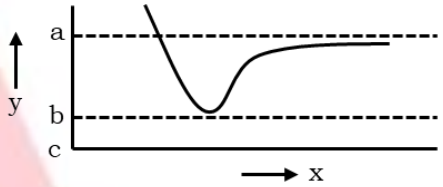
(a) 8, 6

(b) 7, 6

(c) 8, 5

(d) 7, 5

23. The potential energy (y) curve for H_2 formation as a function of internuclear distance (x) of the H atoms is shown below.



The bond energy of H_2 is **(2020 Covid Re-NEET)**

(a) $\frac{(c-a)}{2}$ (b) $\frac{(b-a)}{2}$

(c) $(c-a)$ (d) $(b-a)$

24. Identify the wrongly matched pair. **(2020 Covid Re-NEET)**

Molecule	Shape or geometry of molecule
(a) SF_6	Octahedral
(b) $BeCl_2$	Linear
(c) NH_3	Trigonal pyramidal
(d) PCl_5	Trigonal planar

25. Which of the following diatomic molecular species has only π bonds according to Molecular Orbital Theory? **(2019)**

(a) O_2 (b) N_2

(c) C_2 (d) Be_2

26. Identify the incorrect statement related to PCl_5 from the following: **(2019)**

(a) Three equational P–Cl bonds make an angle of 120° with each other

(b) Two axial P–Cl bonds make an angle of 180° with each other

(c) Axial P–Cl bonds are longer than equatorial P–Cl bonds

(d) PCl_5 molecule is non-reactive

27. Consider the following species: **(2018)**
CN^+, CN^-, NO and CN
Which one of these will have the highest bond order?
(a) NO (b) CN^-
(c) CN (d) CN^+

28. Which of the following statements is incorrect? **(2017-Gujarat)**
(a) Of $\bar{O}-C\equiv\overset{+}{O}, O=C=O$, the structures, $\bar{O}-C\equiv\overset{+}{O}$, is most stable structure
(b) The bond angle follows the order $CH_4 > NH_3 > H_2O > H_2S$
(c) The bond order follows the order $O_2^+ > O_2 > O_2^- > O_2^{2-}$
(d) Strength of 'H' bond follows the order $HF > H_2O > NH_3 > HCl$

29. Which one of the following pair of species have the same bond order? **(2017-Delhi)**
(a) N_2, O_2^- (b) CO, NO
(c) O_2, NO^+ (d) CN^-, CO

30. The species, having bond angles of 120° is **(2017-Delhi)**
(a) BCl_3 (b) PH_3
(c) ClF_3 (d) NCl_3

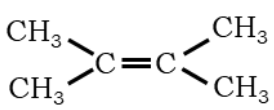
31. Which one of the following ions is not tetrahedral in shape? **(2017-Gujarat)**
(a) $[NiCl_4]^{2-}$ (b) NH_4^+
(c) BF_4^- (d) $[Cu(NH_3)_4]^{2+}$

32. Which of the following pair of species is not iso-structural? **(2017-Gujarat)**
(a) BrO_3^-, XeO_3 (b) ICl_4^-, XeF_4
(c) ClO_3^-, CO_3^{2-} (d) IBr_2^-, XeF_2

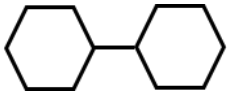
33. Which of the following hydrides has the largest bond angle? **(2017-Gujarat)**
(a) H_2Se (b) H_2S
(c) H_2Te (d) H_2O

34. Which one of the following compounds shows the presence of intramolecular hydrogen bond? **(2016-II)**
(a) Cellulose
(b) Concentrated acid
(c) H_2O_2
(d) HCN

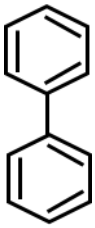
35. In which of the following molecules, all atoms are coplanar? **(2016-II)**
(a)



(b)



(c)



(d)

36. Among the following which one is a wrong statement? **(2016-II)**
(a) SeF_4 and CH_4 have same shape
(b) I_3^+ has bent geometry
(c) PH_5 and $BiCl_5$ do not exist
(d) $p\pi - d\pi$ bonds are present in SO_2

37. The hybridisations of atomic orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ respectively are : **(2016-II)**
(a) sp, sp^3 and sp^2
(b) sp^2, sp^3 and sp
(c) sp, sp^2 and sp^3
(d) sp^2, sp and sp^3

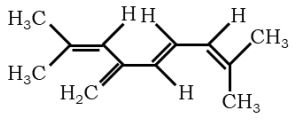
38. Which of the following pairs of ions is isoelectronic and isostructural? **(2016-II)**
(a) CO_3^{2-}, NO_3^-
(b) ClO_3^-, CO_3^{2-}
(c) SO_3^{2-}, NO_3^-
(d) ClO_3^-, SO_3^{2-}

39. Consider the molecules CH_4, NH_3 and H_2O. Which of the given statement is false? **(2016-I)**
(a) The H–C–H bond angle in CH_4 is larger than the H–N–H bond angle in NH_3
(b) The H–C–H bond angle in CH_4, the H–N–H bond angle in NH_3, and the H–O–H bond angle in H_2O are all greater than 90°
(c) Then H–O–H bond angle in H_2O is larger than the H–C–H bond angle in CH_4
(d) The H–O–H bond angle in H_2O is smaller than the H–N–H bond angle in NH_3

40. Predict the correct order among the following: **(2016-I)**
(a) Lone pair – bond pair > bond pair – bond pair > lone pair – lone pair
(b) Lone pair – lone pair > lone pair – bond pair > bond pair – bond pair
(c) Lone pair – lone pair > bond pair – bond pair > lone pair – bond pair
(d) Bond pair – bond pair > lone pair – bond pair > lone pair – lone pair

41. Decreasing order of stability of O_2, O_2^-, O_2^+ and O_2^{2-} is : **(2015 RE)**
(a) $O_2^- > O_2^{2-} > O_2^+ > O_2$
(b) $O_2^+ > O_2 > O_2^- > O_2^{2-}$
(c) $O_2^{2-} > O_2^- > O_2 > O_2^+$
(d) $O_2 > O_2^+ > O_2^{2-} > O_2^-$

42. The total number of π-bond electrons in the following structure is: **(2015)**



(a) 8 (b) 12
(c) 16 (d) 4

43. Which of the following options represents the correct bond order? **(2015)**
(a) $O_2^- < O_2 < O_2^+$
(b) $O_2^- > O_2 < O_2^+$
(c) $O_2^- < O_2 > O_2^+$
(d) $O_2^- > O_2 > O_2^+$

44. The correct bond order in the following species is: **(2015)**
(a) $O_2^{2+} < O_2^- < O_2^+$
(b) $O_2^{2+} < O_2^- < O_2^+$
(c) $O_2^- < O_2^+ < O_2^{2+}$
(d) $O_2^{2+} < O_2^+ < O_2^-$

45. Which of the following pairs of ions are isoelectronic and isostructural? **(2015)**
(a) SO_3^{2-}, NO_3^- (b) ClO_3^-, SO_3^{2-}
(c) CO_3^{2-}, SO_3^{2-} (d) ClO_3^-, CO_3^{2-}

46. Maximum bond angle at nitrogen is present in which of the following? **(2015)**
(a) NO_2^+ (b) $2NO_3^-$
(c) NO_2 (d) NO_2^-

47. Which of the following molecules has the maximum dipole moment? **(2014)**
(a) CH_4 (b) NH_3
(c) NF_3 (d) CO_2

48. Which one of the following species has planar triangular shape? **(2014)**
(a) NO_3^- (b) NO_2^-
(c) CO_2 (d) N_3

49. Which of the following organic compounds has same hybridization as its combustion product (CO_2)? **(2014)**
(a) Ethyne (b) Ethene
(c) Ethanol (d) Ethane

50. Which of the following is a polar molecule? **(2013)**
(a) BF_3 (b) SF_4
(c) SiF_4 (d) XeF_4

51. Which of the following is electron-deficient? **(2013)**
(a) $(CH_3)_2$ (b) $(SiH_3)_2$
(c) $(NH_3)_2$ (d) PH_3

52. Which of the following is paramagnetic? **(2013)**
(a) CO (b) O_2^-
(c) CN (d) NO^+