



Exercise-1

Marked questions are recommended for Revision.

PART - I : SUBJECTIVE QUESTIONS

Section (A) : Back bonding

- A-1. The B–F bond length in $\text{Me}_3\text{N}.\text{BF}_3$ is 1.35 \AA , much longer than 1.30 \AA in BF_3 . Explain.
- A-2. Explain why SiH_3NCO is linear (except H atoms) but CH_3NCO is non linear.
- A-3. Draw the structure : Identify the type ($p\pi-p\pi$, $p\pi-d\pi$) of bonds and number of these bonds in the following molecule :
- (i) SO_3 (ii) H_3PO_4 (iii) N_2 (iv) HClO_4

Section (B) : Electron deficient bonding

- B-1. Explain why
- (i) NH_3 is better e^- pair donor than PH_3 .
- (ii) NH_3 is a better base than CH_3CN ?
- B-2. Why BCl_3 and SiF_4 act as Lewis acids ? Explain.
- B-3. BF_3 exists but BH_3 does not. explain Why.
- B-4. Which orbitals are involved in banana bonding in $\text{Al}_2(\text{CH}_3)_6$.

Section (C) : H-bonding & intermolecular force of attraction.

- C-1. In which of the following the hydrogen bonding is strongest. Explain briefly ?
- (a) $\text{O}-\text{H} \cdots \text{S} (\ell)$ (b) $\text{S}-\text{H} \cdots \text{O} (\ell)$ (c) $\text{F}-\text{H} \cdots \text{F} (\text{s})$ (d) $\text{F}-\text{H} \cdots \text{O} (\ell)$
- C-2. Why D_2O has higher viscosity than H_2O ?
- C-3. Why glucose, fructose, sucrose etc. are soluble in water though they are covalent compounds ?
- C-4. Ethanol has higher boiling point than diethyl ether. Why ?

PART - II : ONLY ONE OPTION CORRECT TYPE

Section (A) : Back bonding

- A-1. For BF_3 molecule which of the following is true ?
- (A) B-atom is sp^2 hybridised.
- (B) There is a $p\pi-p\pi$ back bonding in this molecule.
- (C) Observed B–F bond length is found to be less than the expected bond length.
- (D) All of these
- A-2. Which of the following statements regarding the structure of SOCl_2 is not correct ?
- (A) The sulphur is sp^3 hybridised and it has a tetrahedral shape.
- (B) The sulphur is sp^3 hybridised and it has a trigonal pyramid shape.
- (C) The oxygen-sulphur bond is $p\pi-d\pi$ bond.
- (D) It contain one lone pair of electrons in the sp^3 hybrid orbital of sulphur.
- A-3. Respective order of strength of back-bonding and Lewis acidic strength in boron trihalides is :
- (A) $\text{BF}_3 < \text{BCl}_3 < \text{BBr}_3$ and $\text{BF}_3 < \text{BCl}_3 < \text{BBr}_3$ (B) $\text{BF}_3 > \text{BCl}_3 > \text{BBr}_3$ and $\text{BF}_3 > \text{BCl}_3 > \text{BBr}_3$
- (C) $\text{BF}_3 > \text{BCl}_3 > \text{BBr}_3$ and $\text{BF}_3 < \text{BCl}_3 < \text{BBr}_3$ (D) $\text{BF}_3 < \text{BCl}_3 < \text{BBr}_3$ and $\text{BF}_3 > \text{BCl}_3 > \text{BBr}_3$

Section (B) : Electron deficient bonding

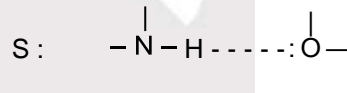
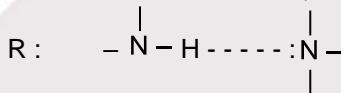
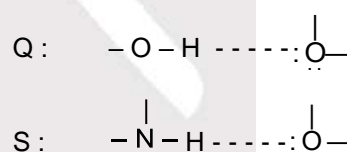
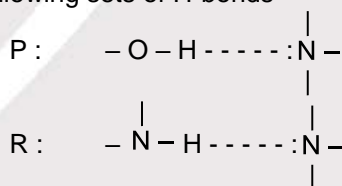
- B-1. Which of the following contains a coordinate covalent bond
- (A) HNO_3 (B) BaCl_2 (C) HCl (D) H_2O



- B-2.** Bonds present in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}(\text{s})$ is
 (A) Electrovalent and covalent (B) Electrovalent and coordinate
 (C) Electrovalent, covalent and coordinate (D) Covalent and coordinate
- B-3.** Electron deficient molecule among the following is :
 (A) I_2Cl_6 (B) B_2H_6 (C) Al_2Cl_6 (D) All of these
- B-4.** For B_2H_6
 S_1 : Each boron is sp^3 hybridised
 S_2 : four terminal 'H' & two 'B' atom are in same plane but two bridge hydrogen in different plane.
 S_3 : It has 4 σ bond & 2 bridge bond
 S_4 : 8 σ bonds are present in it
 (A) T T F F (B) T T T F (C) F F T F (D) F T F T
- B-5.** Which is not true about B_2H_6
 (A) Both 'B' atoms are sp^3 hybridised (B) Boron atom is in ground state
 (C) Two hydrogens occupy special positions (D) There are two, three centre two electron bonds

Section (C) : H-bonding & intermolecular force of attraction.

- C-1.** Which of the following is not correctly matched with respect to the intermolecular forces existing amongst the molecules (Hydrogen bonding is not taken as dipole-dipole attraction) ?
 (A) Benzene – London dispersion forces
 (B) Orthophosphoric acid – London dispersion force, hydrogen bonding.
 (C) Hydrochloric acid – London dispersion force, dipole-dipole attraction
 (D) Iodine monochloride – London dispersion force
- C-2.** Which of the following factor is responsible for van der Waals forces ?
 (A) Instantaneous dipole-induced dipole interaction.
 (B) Dipole-induced dipole interaction and ion-induced dipole interaction.
 (C) Dipole-dipole interaction and ion-induced dipole interaction.
 (D) All of these.
- C-3.** Which of the following bonds/forces is weakest ?
 (A) Covalent bond (B) Ionic bond (C) Hydrogen bond (D) London force
- C-4.** In which of the following compound, intra-molecular H-bonding is not observed :
 (A) o-hydroxy benzaldehyde (B) o-nitrophenol
 (C) Chloral hydrate (D) Boric acid
- C-5.** Consider the following sets of H-bonds



The correct order of H-bond strengths is :

- (A) $\text{Q} > \text{P} > \text{S} > \text{R}$ (B) $\text{R} > \text{Q} > \text{S} > \text{P}$
 (C) $\text{R} > \text{S} > \text{P} > \text{Q}$ (D) $\text{P} > \text{Q} > \text{R} > \text{S}$
- C-6.** Amongst NH_3 , PH_3 , AsH_3 and SbH_3 the one with highest boiling point is :
 (A) NH_3 because of lower molecular weight (B) SbH_3 because of higher molecular weight
 (C) PH_3 because of H-bonding (D) AsH_3 because of lower molecular weight
- C-7.** The correct order of boiling point is :
 (A) $\text{H}_2\text{O} < \text{H}_2\text{S} < \text{H}_2\text{Se} < \text{H}_2\text{Te}$ (B) $\text{H}_2\text{O} > \text{H}_2\text{Se} > \text{H}_2\text{Te} > \text{H}_2\text{S}$
 (C) $\text{H}_2\text{O} > \text{H}_2\text{S} > \text{H}_2\text{Se} > \text{H}_2\text{Te}$ (D) $\text{H}_2\text{O} > \text{H}_2\text{Te} > \text{H}_2\text{Se} > \text{H}_2\text{S}$
- C-8.** Which of the following compounds has the highest boiling point
 (A) HCl (B) HBr (C) H_2SO_4 (D) HNO_3



PART - III : MATCH THE COLUMN

1. Match the following :

	Column-I		Column-II
(A)	BF ₃	(p)	sp ³ hybridization
(B)	(SiH ₃) ₃ N	(q)	pπ–pπ back bond
(C)	B ₂ H ₆	(r)	pπ–dπ back bond
(D)	SiO ₂	(s)	3c–2e bond

2. Match the following :

	Column-I		Column-II
(A)	HCl < HF	(p)	Strength of hydrogen bonding
(B)	PH ₃ < NH ₃	(q)	Dipole moment
(C)	H ₂ O < D ₂ O	(r)	Boiling point
(D)	F ₂ < Cl ₂	(s)	Bond energy

3. Match the column:

Column-I

- (A) Liquid bromine
 (B) Solid hydrogen fluoride
 (C) Solution of sodium fluoride in water
 (D) Liquid methylamine
 (E) Noble gas clathrate in ice.

Column-II

- (p) Hydrogen bond
 (q) Ion-dipole force
 (r) Dispersion force.
 (s) Dipole induced dipole interaction.

Exercise-2

Marked questions are recommended for Revision.

PART - I : ONLY ONE OPTION CORRECT TYPE

- In which of the following compounds B–F bond length is shortest ?
 (A) BF₄[–] (B) BF₃ ← NH₃ (C) BF₃ (D) BF₃ ← N(CH₃)₃
- Which of the following statement is false for trisilylamine ?
 (A) Three sp² orbitals are used for σ bonding, giving a plane triangular structure.
 (B) The lone pair of electrons occupy a p-orbital at right angles to the plane triangle and this overlaps with empty p-orbitals on each of the three silicon atoms resulting in π bonding.
 (C) The N–Si bond length is shorter than the expected N–Si bond length.
 (D) It is a weaker Lewis base than trimethyl amine.
- In which of the following molecules/species all following characteristics are found ?
 (a) Tetrahedral hybridisation
 (b) Hybridisation can be considered to have taken place with the help of empty orbital(s).
 (c) All bond lengths are identical i.e. all A–B bond lengths are identical.
 (A) B₂H₆ (B) Al₂Cl₆ (C) BeCl₂ (g) (D) BF₄[–]
- H-bonding is maximum in
 (A) C₆H₅OH (B) C₆H₅COOH (C) CH₃CH₂OH (D) CH₃COCH₃
- Which one of the following does not have intermolecular H-bonding ?
 (A) H₂O (B) o-nitro phenol (C) HF (D) CH₃COOH
- Give the correct order of initials T or F for following statements. Use T if statement is true and F if it is false.
 S₁ : HF boils at a higher temperature than HCl.
 S₂ : HBr boils at lower temperature than HI.
 S₃ : Bond length of N₂ is less than N₂⁺.
 S₄ : F₂ has higher boiling point than Cl₂.
 (A) T F T T (B) T T F F (C) T T T F (D) T T T T



7. Select the correct statement for the sulphuric acid.
 (I) It has high boiling point and viscosity.
 (II) There are two types of bond lengths in its bivalent anion.
 (III) $p\pi-d\pi$ bonding between sulphur and oxygen is observed.
 (IV) Sulphur has the same hybridisation that is of boron in diborane.
 (A) II and III only (B) II, III and IV only (C) I, III and IV only (D) III and IV only
8. Which of the following is least volatile ?
 (A) HF (B) HCl (C) HBr (D) HI

PART - II : SINGLE AND DOUBLE VALUE INTEGER TYPE

1. How many of the following has hydrogen bonding
 (a) NH_3 (b) CH_4 (c) H_2O (d) HI
 (e) HF (f) HCOOH (g) B(OH)_3 (h) CH_3COOH
 (i) HCO_3^- ion

PART - III : ONE OR MORE THAN ONE OPTIONS CORRECT TYPE

1. Which compounds are lewis acids ?
 (A) AlCl_3 (B) BCl_3 (C) H_2O (D) NH_3
2. Which of the following is/are electron deficient compounds ?
 (A) NaBH_4 (B) B_2H_6 (C) AlCl_3 (D) LiAlH_4
3. Which of the following have coordinate bonds ?
 (A) NH_4Cl (B) NaCl (C) O_3 (D) Cl_2
4. Which of the following is/are correct.
 (A) Boiling point of alcohol is higher than that of diethyl ether
 (B) Density of water is higher than ice.
 (C) Glycerol is more viscous than ethanol
 (D) Ammonia is more easily liquified than HCl due to H-bonding in NH_3
5. Which of the following statements is **correct** regarding phosphoric acid ?
 (A) $p\pi-d\pi$ back bonding exist between O and P.
 (B) The anion is resonance stabilized.
 (C) It is a dibasic acid.
 (D) Inter molecular H bonding between molecules make it a syrupy (viscous) liquid.
6. Which of the following is correct order of strength of hydrogen bonding?
 (A) $\text{N}-\text{H} \cdots \text{N} > \text{N}-\text{H} \cdots \text{O}$ (B) $\text{F}-\text{H} \cdots \text{N} > \text{O}-\text{H} \cdots \text{N}$
 (C) $\text{N}-\text{H} \cdots \text{Cl} > \text{N}-\text{H} \cdots \text{N}$ (D) $\text{O}-\text{H} \cdots \text{F} > \text{O}-\text{H} \cdots \text{O}$

PART - IV : COMPREHENSION

Read the following passage carefully and answer the questions.

Comprehension # 1

Bridge bonding is a specific kind of bonding in pages of chemistry. In general σ -bond pair delocalisation is very difficult. But electron deficiency of the central atom forces to delocalised and forms this kind of bond.

1. The state of hybridisation of central atom in dimer form of both BH_3 and BeH_2 is
 (A) sp^2 , sp (B) sp^3 , sp^2 (C) sp^3 , sp^3 (D) sp^2 , sp^3
2. Which of the following molecule has complete octet
 (A) B_2H_6 (B) Al_2Cl_6 (C) Be_2Cl_4 (D) BeH_2
3. The B_2H_6 molecule is dissolved in tetrahydrofuran. Which atom(s) is/are having changes of hybridisation with respect to reactant and final product of the process given.
 (A) B only (B) B and O (C) B, O and C (D) None of these



4. In which of the dimerisation process, the achievement of the octet is not the driving force.
 (A) $2\text{AlCl}_3 \longrightarrow \text{Al}_2\text{Cl}_6$ (B) $\text{BeCl}_2 \longrightarrow \text{BeCl}_2$ (solid)
 (C) $2\text{ICl}_3 \longrightarrow \text{I}_2\text{Cl}_6$ (D) $2\text{NO}_2 \longrightarrow \text{N}_2\text{O}_4$
5. The molecule is not having $3c - 2e$ bond.
 (A) BeH_2 (dimer) (B) BeH_2 (solid) (C) C_2H_6 (D) B_2H_6

Comprehension # 2

Answer Q.6, Q.7 and Q.8 by appropriately matching the information given in the three columns of the following table.

Observe the three columns in which column-1 represents species, column-2 represents hybridization and shape while column-3 represents properties.					
Column-1		Column-2		Column-3	
Species		Hybridization & shape		Properties	
(I)	O_2	(i)	sp^3	(P)	Paramagnetic
(II)	XeF_2	(ii)	sp^3d	(Q)	Diamagnetic
(III)	H_2O	(iii)	Linear	(R)	H-bond formation
(IV)	ICl_2^+	(iv)	Angular (V-shape)	(S)	Polar nature

6. Correct combination is/are :
 (A) (I) (iii) (q) (B) (II) (i) (p) (C) (I) (iii) (q) (D) (IV) (iii) (p)
7. Correct combination is/are :
 (A) (I) (iii) (q) (B) (II) (iii) (s) (C) (III) (iv) (p) (D) (IV) (i) (s)
8. Incorrect combination is/are :
 (A) (I) (iii) (p) (B) (II) (ii) (q) (C) (III) (i) (r) (D) (IV) (ii) (p)

Exercise-3

* Marked Questions may have more than one correct option.

PART - I : JEE (ADVANCED) / IIT-JEE PROBLEMS (PREVIOUS YEARS)

1. Amongst H_2O , H_2S , H_2Se and H_2Te the one with highest boiling point is : [JEE-2000, 1/135]
 (A) H_2O because of H-bonding. (B) H_2Te because of higher molecular weight.
 (C) H_2S because of H-bonding. (D) H_2Se because of lower molecular weight.
2. Specify the coordination geometry around and hybridisation of N and B atoms in a 1 : 1 complex of BCl_3 & NH_3 . [JEE-2002(S), 3/150]
 (A) N : tetrahedral sp^3 , B : tetrahedral sp^3 (B) N : pyramidal sp^3 , B : pyramidal sp^3
 (C) N : pyramidal sp^3 , B : planar sp^2 (D) N : pyramidal sp^3 , B : tetrahedral sp^3
3. Which one is more soluble in diethyl ether anhydrous AlCl_3 or hydrous AlCl_3 ? Explain in terms of bonding. [JEE-2003(M), 2/144]
4. AlF_3 is insoluble in anhydrous HF but when little KF is added to the compound it becomes soluble. On addition of BF_3 , AlF_3 is precipitated. Write the balanced chemical equations. [JEE-2004(M), 2/144]
5. Predict whether the following molecules are iso-structural or not. Justify your answer. [JEE-2005(M), 2/144]
 (i) NMe_3 (ii) $\text{N}(\text{SiMe}_3)_3$
6. The number of water molecule (s) directly bonded to the metal centre in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ is [JEE-2009, 4/160]
- 7.* Hydrogen bonding plays a central role in the following phenomena : [JEE(Advanced) 2014, 3/120]
 (A) Ice floats in water.
 (B) Higher Lewis basicity of primary amines than tertiary amines in aqueous solutions.
 (C) Formic acid is more acidic than acetic acid.
 (D) Dimerisation of acetic acid in benzene.



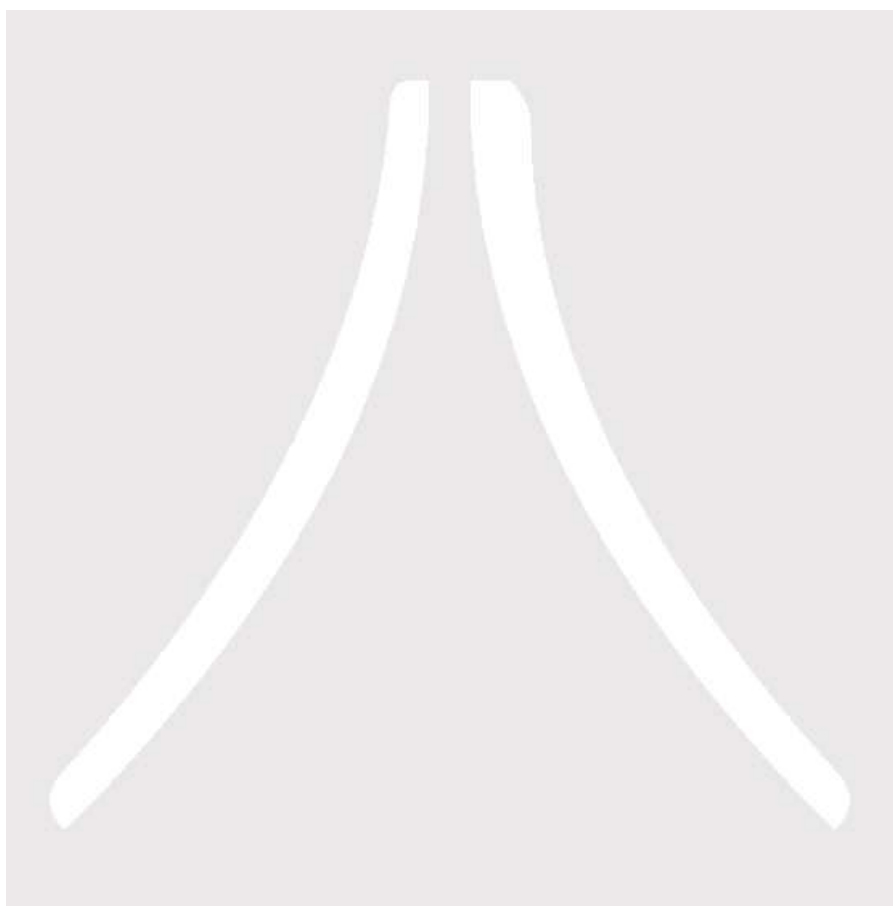
PART - II : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

JEE(MAIN) OFFLINE PROBLEMS

1. The states of hybridization of boron and oxygen atoms in boric acid (H_3BO_3) are respectively :
 (1) sp^2 and sp^2 (2) sp^2 and sp^3 (3) sp^3 and sp^2 (4) sp^3 and sp^3 [AIEEE-2004, 3/225]
2. The structure of diborane (B_2H_6) contains :
 (1) four 2c–2e bonds and four 3c–2e bonds
 (2) two 2c–2e bonds and two 3c–3e bonds
 (3) two 2c–2e bonds and four 3c–2e bonds
 (4) four 2c–2e bonds and two 3c–2e bonds [AIEEE-2005, 4½/225]
3. A metal, M forms chlorides in +2 and +4 oxidation states. Which of the following statements about these chlorides is correct ?
 (1) MCl_2 is more volatile than MCl_4
 (2) MCl_2 is more soluble in anhydrous ethanol than MCl_4
 (3) MCl_2 is more ionic than MCl_4
 (4) MCl_2 is more easily hydrolysed than MCl_4 [AIEEE-2006, 3/165]
4. Which of the following hydrogen bonds is the strongest ?
 (1) $\text{O} - \text{H} \cdots \text{O}$ (2) $\text{O} - \text{H} \cdots \text{F}$ (3) $\text{F} - \text{H} \cdots \text{H}$ (4) $\text{F} - \text{H} \cdots \text{F}$ [AIEEE-2007, 3/120]
5. 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 :
 (1) stronger σ bond between B and F in BF_3 as compared to that between C and F in CF_4 .
 (2) 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 .
 (3) lower degree of $p\pi-p\pi$ interaction between B and F in BF_3 than that between C and F in CF_4 .
 (4) smaller size of B-atom as compared to that of C-atom. [AIEEE-2009, 4/144]
6. What is the best description of the change that occurs when $\text{Na}_2\text{O}(\text{s})$ is dissolved in water ?
 (1) Oxide ion accepts sharing in a pair of electrons
 (2) Oxide ion donates a pair of electrons
 (3) Oxidation number of oxygen increases
 (4) Oxidation number of sodium decreases [AIEEE-2011, 4/120]
7. Which one has the highest boiling point ?
 (1) He (2) Ne (3) Kr (4) Xe [JEE(Main)-2015, 4/120]
8. The intermolecular interaction that is dependent on the inverse cube of distance between the molecules is:
 (1) ion-ion interaction (2) ion-dipole interaction
 (3) London force (4) hydrogen bond [JEE(Main)-2015, 4/120]
9. Which one of the following statements about water is **FALSE** ?
 (1) Water can act both as an acid and as a base.
 (2) There is extensive intramolecular hydrogen bonding in the condensed phase.
 (3) Ice formed by heavy water sinks in normal water.
 (4) Water is oxidized to oxygen during photosynthesis. [JEE(Main)-2016, 4/120]
- 10.* Which of the following are Lewis acids ?
 (1) PH_3 and SiCl_4 (2) BCl_3 and AlCl_3 (3) PH_3 and BCl_3 (4) AlCl_3 and SiCl_4 [JEE(Main)-2018, 4/120]

**JEE(MAIN) ONLINE PROBLEMS**

1. The number of 2-centre-2-electron and 3-centre-2-electron bonds in B_2H_6 , respectively, are:
[JEE(Main) 2019 Online (10-01-19), 4/120]
(1) 2 and 4 (2) 2 and 2 (3*) 4 and 2 (4) 2 and 1
2. The hydride that is NOT electron deficient is :
[JEE(Main) 2019 Online (11-01-19), 4/120]
(1) GaH_3 (2*) SiH_4 (3) AlH_3 (4) B_2H_6





Answers

EXERCISE - 1

PART - I

A-1. In $\text{Me}_3\text{N} \longrightarrow \begin{array}{c} \text{F} \\ | \\ \text{B}-\text{F} \\ | \\ \text{F} \end{array}$, the electron deficiency of boron is compensated by the lone pair of electron donated by nitrogen atom. Whereas in BF_3 it is compensated by back bonding with F atom; back bonding is delocalised thus B-F bond has partial double bond character.

A-2. (Shows $p\pi-d\pi$ bonding) $\begin{array}{c} \text{H} \\ \diagup \\ \text{Si} = \text{N} = \text{C} = \text{O} \\ \diagdown \quad \text{sp} \\ \text{H} \end{array}$

(Cannot show $p\pi-d\pi$ bonding) $\begin{array}{c} \text{H} \\ \diagup \\ \text{C} - \ddot{\text{N}} = \text{C} = \text{O} \\ \diagdown \quad \text{sp}^2 \\ \text{H} \end{array}$

A-3. (i) $\begin{array}{c} \text{O} \\ || \\ \text{S} \\ || \\ \text{O} \end{array}$ two $p\pi-d\pi$ bond and one $p\pi-p\pi$ bond.

(ii) $\begin{array}{c} \text{O} \\ || \\ \text{P} \\ / \quad | \quad \backslash \\ \text{HO} \quad \text{OH} \quad \text{OH} \end{array}$ one $p\pi-d\pi$ bond

(iii) $\text{N} \equiv \text{N}$ two $p\pi-p\pi$ bond.

(iv) $\begin{array}{c} \text{O} \\ || \\ \text{H} - \text{O} - \text{Cl} = \text{O} \\ || \\ \text{O} \end{array}$ three $p\pi-d\pi$ bond.

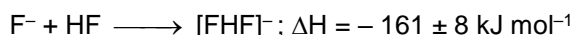
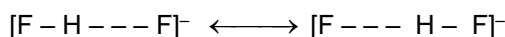
B-1. (i) In NH_3 molecule N atom has lone pair in sp^3 hybrid orbital while in PH_3 as suggested by its bond angle (92°) the lone pair must be present in 's' orbital which is much more contracted than sp^3 . Hence PH_3 becomes a poor donor than NH_3 .
(ii) CH_3CN has lone pair on sp hybridized nitrogen atom while NH_3 has lone pair on sp^3 hybridized nitrogen atom.

B-2. In BCl_3 , octet of Boron is incomplete. In SiF_4 , silicon has vacant d-orbitals, by which it can accept electron pair.

B-3. BF_3 molecule being electron deficient gets stabilised through $p\pi-p\pi$ back bonding. whereas BH_3 removes its electron deficiency through dimerisation and thus exists as B_2H_6 .

B-4. sp^3 hybridised orbital of both aluminium and sp^3 hybridised orbital of carbon.

C-1. Very strong hydrogen bonding occurs in the alkali metal hydrogen fluorides of formula $\text{M}[\text{HF}_2]$; there is a linear symmetrical anion having an overall, F-H-F distance of 2.26 Å.



C-2. Deuterium is more electropositive than hydrogen. Therefore, stronger H-bonding is found in D_2O than in H_2O . D_2O is also denser than H_2O .

C-3. These compounds contain polar -OH groups which can form H-bonds with water.

C-4. In ethanol, there is H-bonding but in diethyl ether, there is no H-bonding (because O-atom is attached to C-atom) but there exists weak dipole-dipole attraction in diethyl ether.



PART – II

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|----------|----------|----------|----------|----------|
| A-1. (D) | A-2. (A) | A-3. (C) | B-1. (A) | B-2. (C) |
| B-3. (B) | B-4. (B) | B-5. (B) | C-1. (D) | C-2. (D) |
| C-3. (D) | C-4. (D) | C-5. (D) | C-6. (B) | C-7. (D) |
| C-8. (C) | | | | |

PART – III

- (A - q) ; (B - r) ; (C - s,p) ; (D - p, r)
- (A - p, q, r, s) ; (B - p, q, r, s) ; (C - p, q, r, s) ; (D - r, s)
- (A - r) ; (B - p, r) ; (C - p, q, r) ; (D - p, r) ; (E - p, r, s).

EXERCISE - 2

PART – I

- | | | | | |
|--------|--------|--------|--------|--------|
| 1. (C) | 2. (B) | 3. (D) | 4. (B) | 5. (B) |
| 6. (C) | 7. (C) | 8. (A) | | |

PART – II

- 7 (Except (b, d))

PART – III

- | | | | | |
|---------|---------|---------|-----------|----------|
| 1. (AB) | 2. (BC) | 3. (AC) | 4. (ABCD) | 5. (ABD) |
| 6. (AB) | | | | |

PART – IV

- | | | | | |
|--------|--------|--------|--------|--------|
| 1. (B) | 2. (B) | 3. (D) | 4. (C) | 5. (C) |
| 6. (C) | 7. (D) | 8. (D) | | |

EXERCISE – 3

PART – I

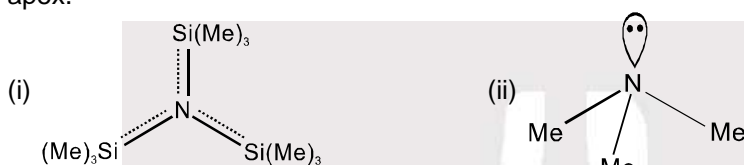
- (A)
- (A)
- In diethyl ether ($\text{C}_2\text{H}_5-\ddot{\text{O}}-\text{C}_2\text{H}_5$) oxygen atom has two lone pairs of electrons, thus acts as Lewis base while in anhydrous AlCl_3 aluminium has vacant 3p-orbital of valence shell and thus acts as Lewis acid. AlCl_3 accepts a lone pair of electrons from diethyl ether to complete its octet forming a complex $\text{C}_2\text{H}_5-\text{O}:\rightarrow\text{AlCl}_3$. Hence, anhydrous AlCl_3 is more soluble in diethyl ether by means of solvolysis in comparison to hydrous AlCl_3 (i.e., $\text{AlCl}_3 \cdot 6\text{H}_2\text{O}$). Hydrous AlCl_3 is a polar compound, while ether is non-polar, so on basis of Thumb's rule, like dissolve in like solvents. Hence hydrous AlCl_3 is least soluble in ether.



4. There is inter molecular hydrogen bonding in HF and because of this it is weakly dissociated. So AlF_3 is not soluble in anhydrous HF. On the other hand KF is ionic compound and thus it is highly dissociated giving a high concentration of F^- ion which leads to the formation of a colourless soluble complex,

$$\text{AlF}_3 + \text{KF} \longrightarrow \text{K}_3[\text{AlF}_6]$$
 BF_3 is more acidic than AlF_3 because of the small size of B than that of Al. Thus BF_3 pulls out F^- from $[\text{AlF}_6]^{3-}$ forming $[\text{BF}_4]^-$ and AlF_3 . Hence AlF_3 is precipitated on adding BF_3 to $[\text{AlF}_6]^{3-}$.

$$\text{K}_3[\text{AlF}_6] + 3\text{BF}_3 \longrightarrow 3\text{K}[\text{BF}_4] + \text{AlF}_3 \downarrow$$
5. (i) $\text{N}(\text{SiMe}_3)_3$ is trigonal planar because in it silicon uses its vacant d-orbital for $p\pi-d\pi$ back bonding with lone pair of electrons of central N-atom and the $p\pi-d\pi$ bonding is delocalised as given in the structure. So, $\text{N}(\text{SiMe}_3)_3$ with steric number three is trigonal planar.
 (ii) In $\text{N}(\text{Me}_3)$, there is no such $p\pi-d\pi$ delocalisation of lone pair of electrons on N atom as carbon does not have vacant d-orbital. So $\text{N}(\text{Me}_3)$ with steric number four is trigonal pyramidal with a lone pair at the apex.



Hence both are not isostructural.

6. 4 7. (ABD)

PART – II

JEE(MAIN) OFFLINE PROBLEMS

- | | | | | |
|--------|--------|--------|--------|------------|
| 1. (1) | 2. (4) | 3. (3) | 4. (4) | 5. (2) |
| 6. (2) | 7. (4) | 8. (4) | 9. (2) | 10.* (2,4) |

JEE(MAIN) ONLINE PROBLEMS

- | | |
|--------|--------|
| 1. (3) | 2. (2) |
|--------|--------|