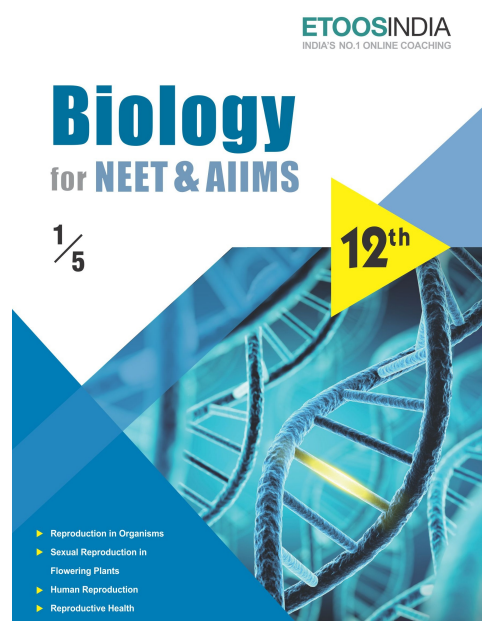
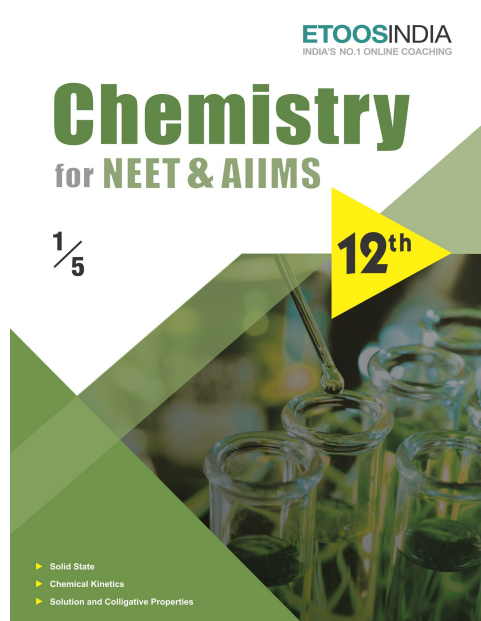
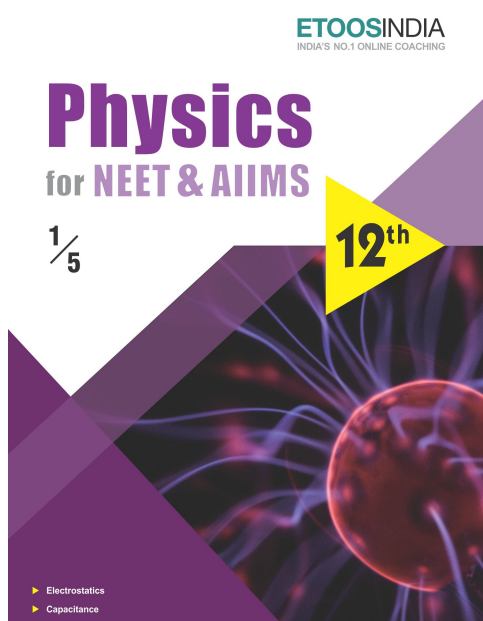
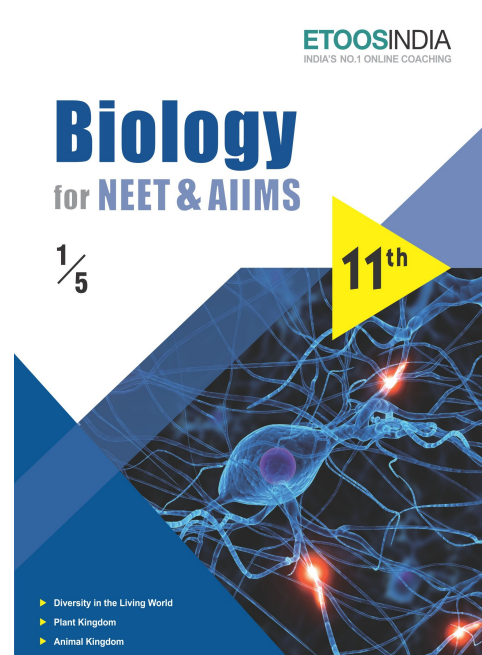
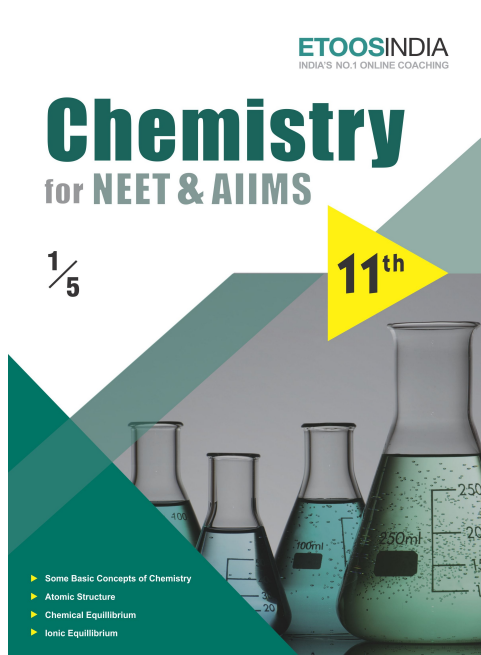
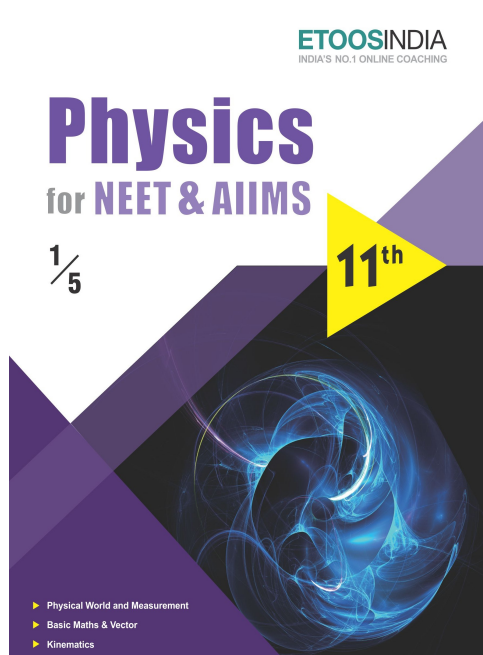


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# CHEMICAL BONDING

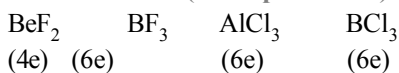
*The nature of the chemical bond is the problem at the heart of all chemistry.*

“BRYCE CRAWFORD”

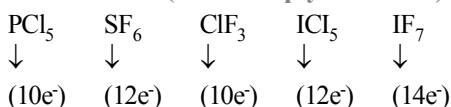
## INTRODUCTION

The attractive force which holds various constituents (atoms, ions, etc.) together in different chemical species is called a chemical bond. Since the formation of chemical compounds takes place as a result of combination of atoms of various elements in different ways, it raises many questions. Why do atoms combine? Why are only certain combinations possible? Why do molecules possess definite shapes? To answer such questions different theories and concepts have been put forward from time to time. These are Kossel-Lewis approach, Valence Shell Electron Pair Repulsion (VSEPR) Theory, Valence Bond (VB) Theory and Molecular orbital and the interpretation of the nature of chemical bonds have closely been related to the developments in the understanding of the structure of atom, the electronic configuration of elements and the periodic table. Every system tends to be more stable and bonding is nature's way of lowering the energy of the system to attain stability.

**Contraction of Octet (Incomplete Octet)**

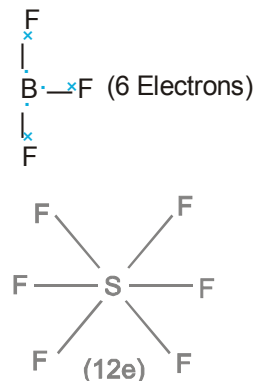
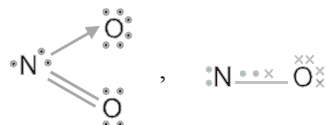


**Expansion of Octet (Due to Empty d-Orbitals)**



**Odd Electron Species**

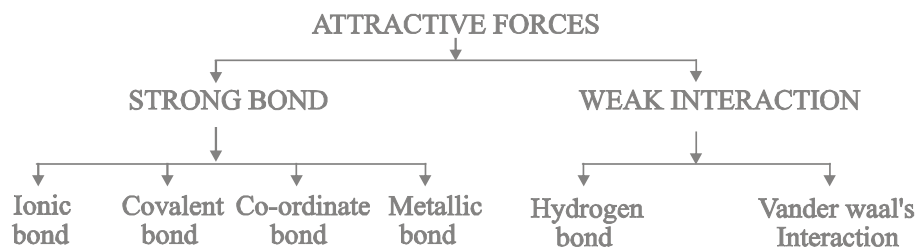
Ex. NO, NO<sub>2</sub>, ClO<sub>2</sub> etc.



**Compounds of Noble Gases**

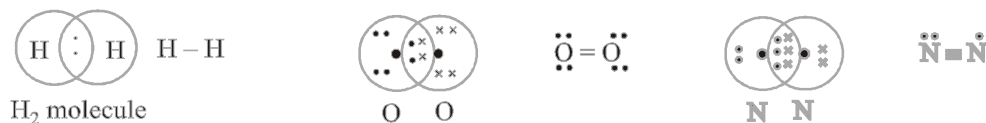
Noble gases which have already completed their octets (or duplet in case of He.) should not form compounds. However, their compounds like XeF<sub>2</sub>, XeF<sub>6</sub> & KrF<sub>2</sub> etc., have been actually prepared.

**CLASSIFICATION OF BONDS**



**Covalent Bond**

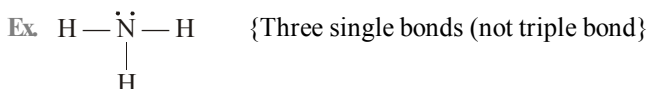
(a) A covalent bond is formed by the mutual sharing of electrons between two atoms of electronegativity elements to complete their octet. (Except H which completes its duplet)



(b) The shared pair of electrons should have opposite spins, and are localised between two atoms concerned.

(c) Sharing of electrons may occurs in three ways –

No. of electrons shared between two atoms	Bonded Electron pair	Bond
2	1	Single bond (–)
4	2	Double bond (=)
6	3	Triple bond (≡)



N≡N Triple bond. (not three single bond) O=O (Double bond) H–O–H (Two single bonds.)


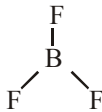
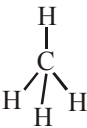
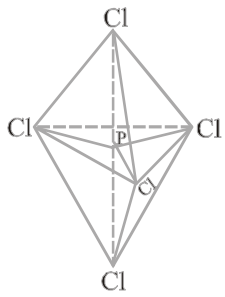
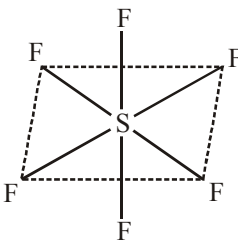
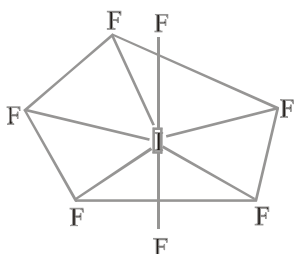
**Co-ordinate Bond**

(a) It is a covalent bond in which the shared electron pair come from one atom is called coordinate bond.

(b) Necessary conditions for the formation of co-ordinate bond are -

- (i) Octet of donor atom should be complete and should have atleast one lone pair of electron.

*Etoos Tips & Formulas*

Sr. No.	Hybridisation	Structure	Bond Angle	Examples
1.	sp	Linear 	180°	BeF <sub>2</sub>
2.	sp <sup>2</sup>	Triagonal planar 	120°	BF <sub>3</sub>
3.	sp <sup>3</sup>	Tetrahedral 	109°28'	CH <sub>4</sub>
4.	sp <sup>3</sup> d	Trigonal bipyramidal  Structure of PCl <sub>5</sub>	3 orbitals-120° 2 perpendicular orbitals	PCl <sub>5</sub>
5.	sp <sup>3</sup> d <sup>2</sup>	Octahedral 	90° between all hybrid orbitals	SF <sub>6</sub>
6.	sp <sup>3</sup> d <sup>3</sup>	pentagonalbipiramidal 	5 bond angle 72° and 10 bond angles 90°	IF <sub>7</sub>

SOLVED EXAMPLE

Ex. 1 Which of the following will be strongest Lewis base ?

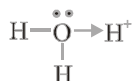
- (A) CH<sub>3</sub>CN (B) CH<sub>3</sub>NH<sub>2</sub>  
(C) N<sub>2</sub> (D) None of these

Sol. (B) In CH<sub>3</sub>NH<sub>2</sub>, hybridisation of N is sp<sup>3</sup> while in CH<sub>3</sub>CN hybridisation of N is sp. N<sub>2</sub> is also sp hybridised.

We know that in hybridisation, as s-character increases the electronegativity of atom also increases. Due to this tendency the release of lone pair of electrons becomes somewhat difficult. In methyl amine the nitrogen is in sp<sup>3</sup> hybridisation and therefore the donation of the lone pair of electron will be quite easier; so it is strongest Lewis base.

Ex. 2 Which type of hybridisation is found in H<sub>3</sub>O<sup>+</sup> ?

Sol. According to steric no. rule  
Steric number = Number of bond pair(s) + number of lone pair(s) at central atom



So, steric number = 3 + 1 = 4.

Thus the hybridisation of oxygen in H<sub>3</sub>O<sup>+</sup> is sp<sup>3</sup>.

Ex. 3 Classify the following bonds as ionic, polar covalent or covalent and give your reasons :

- (A) SiSi bond in Cl<sub>3</sub>SiSiCl<sub>3</sub>  
(B) SiCl bond in Cl<sub>3</sub>SiSiCl<sub>3</sub>  
(C) CaF bond in CaF<sub>2</sub>  
(D) NH bond in NH<sub>3</sub>

Sol. (A) Covalent, due to identical electronegativity.  
(B) Covalent, due to less electronegativity difference.  
(C) Ionic, due to more electronegativity difference.  
(D) Covalent, due to nearly similar electronegativity.

Ex. 4 (A) Which one has highest and lowest melting point and why ?



(B) Why melting points of cesium halide (CsX) decrease in the order given below ?

CsF > CsCl > CsBr > CsI.

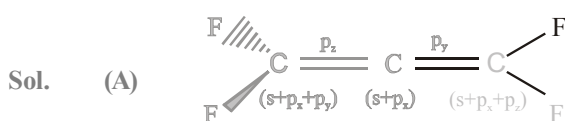
Sol. (A) NaCl will have highest lattice energy on account of the smaller Na<sup>+</sup> while CsCl has lowest lattice energy on account of the larger Cs<sup>+</sup>. Hence NaCl has highest melting point and CsCl has lowest melting point.

(B) As size of anions increase their polarisability increases thus their covalent character increases and melting point decrease.

Ex. 5 Which is incorrect statement ?

- (A) In CF<sub>2</sub>=C=CF<sub>2</sub> molecule all the four fluorine atoms are not in the same plane.  
(B) Ka<sub>2</sub> of fumaric acid is more than Ka<sub>2</sub> of maleic acid due to intra molecular hydrogen bonding in maleic acid.  
(C) The O—O bond length in O<sub>2</sub>[AsF<sub>4</sub>] is longer than KO<sub>2</sub>.  
(D) The bond angle order in halogen—S—halogen is OSF<sub>2</sub> < OSCl<sub>2</sub> < OSBr<sub>2</sub>

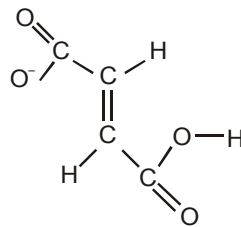
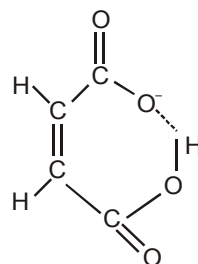
Ans. (C)



As both carbon atoms are in different planes, all the four fluorine atoms are not in the same plane.

(B) maleic acid

fumaric acid



Due to intramolecular hydrogen bonding the maleate ion gets stabilized and thus removal of second hydrogen becomes quite difficult.

- (C) O<sub>2</sub>[AsF<sub>4</sub>] = O<sub>2</sub><sup>+</sup>    B.O = 2.5  
KO<sub>2</sub> = O<sub>2</sub><sup>-</sup>    B.O = 1.5

Bond order ∝  $\frac{1}{\text{bond length}}$  ; so O<sub>2</sub><sup>+</sup> has smaller bond length than O<sub>2</sub><sup>-</sup>

(D) Greater the size of the halogen atoms greater will be the steric repulsions and thus larger will be the bond angles.

Ex. 6 Which of the compounds MgCO<sub>3</sub> and ZnCO<sub>3</sub> is thermally more stable ? Explain.

Sol. Mg<sup>2+</sup> has less polarising power due to inert gas configuration while Zn<sup>2+</sup> has higher polarising power due to pseudo inert gas configuration. A cation i.e. Zn<sup>2+</sup> with a greater, polarising power exercise a

**Exercise # 1**

**SINGLE OBJECTIVE**

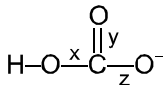
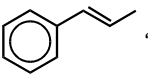
**NEET LEVEL**

- Which forms a crystal of NaCl  
(A) NaCl molecules (B) Na<sup>+</sup> and Cl<sup>-</sup> ions  
(C) Na and Cl atoms (D) None of the above
- When sodium and chlorine reacts then  
(A) Energy is released and ionic bond is formed  
(B) Energy is released and a covalent bond is formed  
(C) Energy is absorbed and ionic bond is formed  
(D) Energy is absorbed and covalent bond is formed
- Which one is least ionic in the following compounds  
(A) AgCl (B) KCl  
(C) BaCl<sub>2</sub> (D) CaCl<sub>2</sub>
- The valency of sulphur in sulphuric acid is  
(A) 2 (B) 4  
(C) 6 (D) 8
- The number of electrons involved in the bond formation of N<sub>2</sub> molecule  
(A) 2 (B) 4  
(C) 6 (D) 10
- The electronic configuration of four elements are given in brackets  
L(1s<sup>2</sup>, 2s<sup>2</sup> 2p<sup>1</sup>); M(1s<sup>2</sup>, 2s<sup>2</sup> 2p<sup>5</sup>)  
Q(1s<sup>2</sup>, 2s<sup>2</sup> 2p<sup>6</sup>, 3s<sup>1</sup>); R(1s<sup>2</sup>, 2s<sup>2</sup> 2p<sup>2</sup>)  
The element that would most readily form a diatomic molecule is  
(A) Q (B) M  
(C) R (D) L
- Which species has the maximum number of lone pair of electrons on the central atom?  
(A) [ClO<sub>3</sub>]<sup>-</sup> (B) XeF<sub>4</sub>  
(C) SF<sub>4</sub> (D) [I<sub>3</sub>]<sup>-</sup>
- A simple example of a coordinate covalent bond is exhibited by  
(A) C<sub>2</sub>H<sub>2</sub> (B) H<sub>2</sub>SO<sub>4</sub>  
(C) NH<sub>3</sub> (D) HCl
- The bond that exists between NH<sub>3</sub> and BF<sub>3</sub> is called  
(A) Electrovalent (B) Covalent  
(C) Coordinate (D) Hydrogen
- Which of the following does not have a coordinate bond  
(A) SO<sub>2</sub> (B) HNO<sub>3</sub>  
(C) H<sub>2</sub>SO<sub>4</sub> (D) HNO<sub>2</sub>
- Which molecules has zero dipole moment  
(A) H<sub>2</sub>O (B) CO<sub>2</sub>  
(C) HF (D) HBr
- In the following which one have zero dipole moment  
(A) BF<sub>3</sub> (B) CCl<sub>4</sub>  
(C) BeCl<sub>2</sub> (D) All of these
- Which molecule has the largest dipole moment  
(A) HCl (B) HI  
(C) HBr (D) HF
- The unequal sharing of bonded pair of electrons between two atoms in a molecule causes  
(A) Dipole  
(B) Radical formation  
(C) Covalent bond  
(D) Decomposition of molecule
- Which one in the following is not the resonance structure of  
(A) O=C=O (B) <sup>-</sup>O-C≡O<sup>+</sup>  
(C) <sup>+</sup>O≡C-O<sup>-</sup> (D) O≡C=O
- Which of the following molecule contains one pair of non-bonding electrons  
(A) CH<sub>4</sub> (B) NH<sub>3</sub>  
(C) H<sub>2</sub>O (D) HF
- Resonance is due to  
(A) Delocalization of sigma electrons  
(B) Delocalization of pi electrons  
(C) Migration of H atoms  
(D) Migration of protons
- Resonating structures have different  
(A) Atomic arrangements  
(B) Electronic arrangements  
(C) Functional groups  
(D) Alkyl groups
- The structure of [Cu(H<sub>2</sub>O)<sub>4</sub>]<sup>++</sup> ion is  
(A) Square planar (B) Tetrahedral  
(C) Distorted rectangle (D) Octahedral
- The bond angle in PH<sub>3</sub> would be expected to be close to  
(A) 90° (B) 105°  
(C) 109° (D) 120°
- In which molecule are all atoms coplanar  
(A) CH<sub>4</sub> (B) BF<sub>3</sub>  
(C) PF<sub>3</sub> (D) NH<sub>3</sub>

Exercise # 2

SINGLE OBJECTIVE

AIIMS LEVEL

- Pick out among the following species isoelectronic with  $\text{CO}_2$ .  
 (A)  $\text{N}_3^-$  (B)  $(\text{CNO})^-$   
 (C)  $(\text{NCN})^{2-}$  (D) All of these
- The correct order of increasing C-O bond length of  $\text{CO}$ ,  $\text{CO}_3^{2-}$ ,  $\text{CO}_2$  is :  
 (A)  $\text{CO}_3^{2-} < \text{CO}_2 < \text{CO}$  (B)  $\text{CO}_2 < \text{CO}_3^{2-} < \text{CO}$   
 (C)  $\text{CO} < \text{CO}_3^{2-} < \text{CO}_2$  (D)  $\text{CO} < \text{CO}_2 < \text{CO}_3^{2-}$
- The average charge on each O atom and average bond order of I-O bond in  $\text{IO}_6^{5-}$  is :  
 (A) -1 and 1.67 (B) -5/6 and 1.67  
 (C) -5/6 and 1.33 (D) -5/6 and 1.167
-  The relation between x, y and z in bicarbonate ion with respect to bond length is :  
 (A)  $x > y > z$  (B)  $x > z > y$   
 (C)  $z > y > x$  (D)  $x > y = z$
- Indicate the wrong statement :  
 (A) A sigma bond is stronger than  $\pi$  - bond  
 (B) p-orbitals always have only sidewise overlapping  
 (C) s-orbitals never form  $\pi$  - bonds  
 (D) There can be only one sigma bond between two atoms
- $\text{C}_3^{4+}$  has  
 (A) two  $\sigma$  and two  $\pi$  bond  
 (B) three  $\sigma$  and one  $\pi$  bond  
 (C) two  $\sigma$  and one  $\pi$  bond  
 (D) two  $\sigma$  and three  $\pi$  bond
- How many bonds are there in  ?  
 (A) 13 (B) 23  
 (C) 20 (D) 26
- Which of the following overlaps is **incorrect** [assuming z-axis to be the internuclear axis] ?  
 (A)  $2 p_y + 2 p_y \rightarrow \pi 2 p_y$   
 (B)  $2 p_z + 2 p_z \rightarrow \sigma 2 p_z$   
 (C)  $2 p_x + 2 p_x \rightarrow \pi 2 p_x$   
 (D)  $1 s + 2 p_y \rightarrow \pi (1 s - 2 p_y)$
- Effective overlapping will be shown by :  
 (A)  $\oplus\oplus + \oplus\oplus$  (B)  $\oplus + \oplus$   
 (C)  $\oplus\oplus + \oplus\oplus$  (D) All the above
- The covalency of nitrogen in  $\text{HNO}_3$  is  
 (A) 0 (B) 3  
 (C) 4 (D) 5
- What is covalency of I in  $\text{IF}_7$  ?  
 (A) 5 (B) 3  
 (C) 7 (D) 1
- In which of the following N is in the  $sp^2$  hybridisation state  
 (A)  $(\text{CH}_3)_3\text{N}$  (B)  $\text{CH}_3\text{CONH}_2$   
 (C)  $\text{CH}_3\text{CN}$  (D)  $\text{NO}_2^+$
- In pent-3-en-1-yne the terminal carbon-atoms have following hybridisation  
 (A)  $sp$  &  $sp^2$  (B)  $sp^2$  &  $sp^3$   
 (C)  $sp^2$  &  $sp$  (D)  $sp$  &  $sp^3$
- Identify the correct match.  
 (i)  $\text{XeF}_2$   
 (A) Central atom has  $sp^3$  hybridisation and bent geometry.  
 (ii)  $\text{N}_3^-$   
 (B) Central atom has  $sp^3d^2$  hybridisation and octahedral.  
 (iii)  $\text{PCl}_6^-(\text{PCl}_5(\text{s}) \text{ anion})$   
 (C) Central atom has  $sp$  hybridisation and linear geometry.  
 (iv)  $\text{ICl}_2^+(\text{I}_2\text{Cl}_6(\ell) \text{ cation})$   
 (D) Central atom has  $sp^3d$  hybridisation and linear geometry.  
 (A) (i - a), (ii - b), (iii - c), (iv - d)  
 (B) (i - d), (ii - b), (iii - d), (iv - c)  
 (C) (i - b), (ii - c), (iii - a), (iv - d)  
 (D) (i - d), (ii - c), (iii - b), (iv - a)

**Exercise # 3**

**PART - 1**

**MATRIX MATCH COLUMN**

1. **Column-I**

- (A)  $H_3P_3O_9$
- (B)  $H_2S_2O_7$
- (C)  $H_2S_4O_6$
- (D)  $H_4P_2O_5$

**Column-II**

- (p) S–O–S bond is present
- (q) Di-basic acid
- (r) P–O–P bond is present
- (s) Central atom (S or P) in maximum oxidation state.

2. **Column-I**

- (A)  $N_2^+$  is stable than  $N_2^-$
- (B) NO can easily lose its electron than  $N_2$
- (C) NO have large bond length than  $NO^+$
- (D)  $He_2^+$  exists, but is less stable than  $H_2^+$

**Column-II**

- (p) due to one have greater number of electrons in antibonding molecular orbitals than other
- (q) one has B.O. 3 and other has 2.5
- (r) both are paramagnetic with same bond order
- (s) one is paramagnetic and other diamagnetic

3. **Column – I**

- (A)  $SO_3$  (gas)
- (B)  $OSF_4$
- (C)  $SO_3F^-$
- (D)  $ClOF_3$

**Column – II**

- (p) Polar with  $p\pi-d\pi$  bonds and identical S–O bond, lengths.
- (q) One lone pair and  $p\pi-d\pi$  bond.
- (r) Non-polar with  $p\pi-p\pi$  and  $p\pi-d\pi$  bonds. Identical S–O bond lengths.
- (s) Polar with  $p\pi-d\pi$  bond.

4. **Column – I**

- (A)  $IF_2^-$
- (B)  $ClF_3$
- (C)  $XeO_3F_2$
- (D)  $SF_4$

**Column – II**

- (p)  $sp^3d$
- (q) polar
- (r) one of the bond angles is  $180^\circ$ .
- (s) one lone pair

5. **Column-I**

- (A) Blue vitriol
- (B) Gypsum
- (C) Pure orthophosphoric acid
- (D) Chloral hydrate

**Column-II**

- (p) Ionic bond
- (q) Covalent bond
- (r) Hydrogen bond
- (s) Resonance stabilisation



Exercise # 4

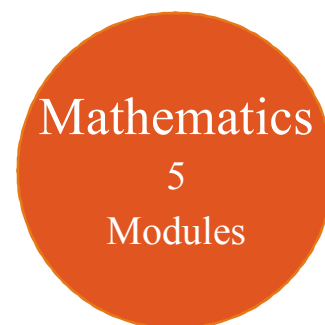
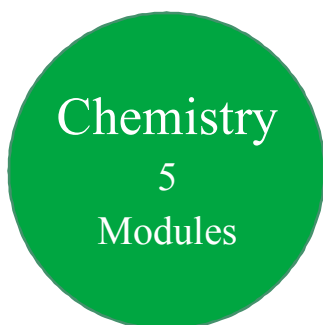
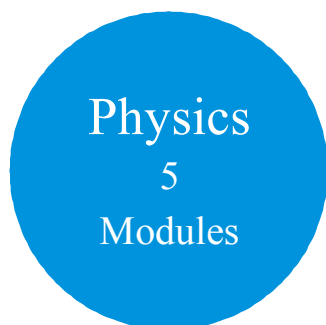
PART - 1

PREVIOUS YEAR (NEET/AIPMT)

- Which one of the following molecules will form a linear polymeric structure due to hydrogen bonding ? [CBSE AIPMT 2000]  
 (A)  $\text{NH}_3$  (B)  $\text{H}_2\text{O}$   
 (C)  $\text{HCl}$  (D)  $\text{HF}$
- Which one of the following is planar ? [CBSE AIPMT 2000]  
 (A)  $\text{XeF}_4$  (B)  $\text{XeO}_4$   
 (C)  $\text{XeO}_3\text{F}$  (D)  $\text{XeO}_3\text{F}_2$
- The relationship between the dissociation energy of  $\text{N}_2$  and  $\text{N}_2^+$  is [CBSE AIPMT 2000]  
 (A) dissociation energy of  $\text{N}_2^+ >$  dissociation energy of  $\text{N}_2$   
 (B) dissociation energy of  $\text{N}_2 =$  dissociation energy of  $\text{N}_2^+$   
 (C) dissociation energy  $\text{N}_2 >$  dissociation energy of  $\text{N}_2^+$   
 (D) dissociation energy of  $\text{N}_2$  can either be lower or higher than the dissociation energy of  $\text{N}_2^+$
- Which one of the following is not paramagnetic ? [CBSE AIPMT 2000]  
 (A)  $\text{NO}$  (B)  $\text{N}_2^+$   
 (C)  $\text{CO}$  (D)  $\text{O}_2^-$
- Among the following group which represents the collection of isoelectronic species ? [CBSE AIPMT 2000]  
 (A)  $\text{NO}, \text{CN}^-, \text{N}_2, \text{O}_2^-$   
 (B)  $\text{NO}^+, \text{CO}_2^{2-}, \text{O}_2^-, \text{CO}$   
 (C)  $\text{N}_2, \text{C}_2^{2-}, \text{CO}, \text{NO}$   
 (D)  $\text{CO}, \text{NO}^+, \text{CH}^-, \text{C}_2^{2-}$
- Among the following group which represents the collection of isoelectronic species ? [CBSE AIPMT 2000]  
 (A)  $\text{NO}_2^-$  (B)  $\text{NO}_3^-$   
 (C)  $\text{PO}_4^{3-}$  (D)  $\text{CO}_3^{2-}$
- A compound contains atoms of three elements A, B and C. If the oxidation number of A is +2, B is +5 and that of C is -2, the possible formula of the compound is [CBSE AIPMT 2000]  
 (A)  $\text{A}_2(\text{BC}_3)_2$  (B)  $\text{A}_3(\text{BC}_4)_2$   
 (C)  $\text{A}_3(\text{B}_4\text{C})_2$  (D)  $\text{ABC}_2$
- Which of the following two are isostructural ? [CBSE AIPMT 2001]  
 (A)  $\text{XeF}_2$ , and  $\text{IF}_2^-$  (B)  $\text{NH}_3$ , and  $\text{BF}_3$   
 (C)  $\text{CO}_3^{2-}$ , and  $\text{SO}_3^{2-}$  (D)  $\text{PCl}_5$ , and  $\text{Icl}_5$
- In which of the following, bond angle is maximum ? [CBSE AIPMT 2001]  
 (A)  $\text{NH}_3$  (B)  $\text{NH}_4^+$   
 (C)  $\text{PCl}_3$  (D)  $\text{SCL}_2$
- In  $\text{X}-\text{H} \cdots \text{Y}$ , X and Y both are electronegative elements, then [CBSE AIPMT 2001]  
 (A) electron density on X will increase and on H will decrease  
 (B) in both electron density will increase  
 (C) in both electron density will decrease  
 (D) on X electron density will decrease and on H increase
- Main axis of a diatomic molecule is z molecular orbital,  $p_x$  and  $p_y$  overlaps to form which of the following orbitals ? [CBSE AIPMT 2001]  
 (A)  $\pi$ -molecular orbital (B)  $\sigma$ -molecular orbital  
 (C)  $\delta$ -molecular orbital (D) NO bond will form
- Which of the following is isoelectronic ? [CBSE AIPMT 2002]  
 (A)  $\text{CO}_2, \text{NO}_2$  (B)  $\text{NO}_2^-, \text{CO}_2$   
 (C)  $\text{CN}^-, \text{Co}$  (D)  $\text{SO}_2, \text{CO}_2$
- Which of the following has  $p\pi - d\pi$  bonding ? [CBSE AIPMT 2002]  
 (A)  $\text{NO}_3^-$  (B)  $\text{SO}_3^{2-}$   
 (C)  $\text{BO}_3^{3-}$  (D)  $\text{CO}_3^{2-}$
- In  $\text{NO}_3^-$  ion number of bond pair and lone pair of electrons on nitrogen atom are [CBSE AIPMT 2002]  
 (A) 2, 2 (B) 3, 1  
 (C) 1, 3 (D) 4, 0
- Which of the following statement is not correct for sigma and pi-bonds formed between two carbon atoms ? [CBSE AIPMT 2003]  
 (A) Free rotation of atoms about a sigma bond is allowed but not in case of a pi-bond  
 (B) Sigma bond determines the direction between carbon atoms but a pi-bond has no primary effect in this regard  
 (C) Sigma bond is stronger than a pi-bond  
 (D) Bond energies of sigma and pi-bonds are of the order of 264 kJ/mol and 347 kJ/mol. respectively

- Among the following species, identify the isostructural pairs,  $\text{NF}_3$ ,  $\text{NO}_3^-$ ,  $\text{BF}_3$ ,  $\text{H}_3\text{O}^+$ ,  $\text{HN}_3$ 
  - $[\text{NF}_3, \text{NO}_3^-]$  and  $[\text{BF}_3, \text{H}_3\text{O}^+]$
  - $[\text{NF}_3, \text{HN}_3]$  and  $[\text{NO}_3^-, \text{BF}_3]$
  - $[\text{NF}_3, \text{H}_3\text{O}^+]$  and  $[\text{NO}_3^-, \text{BF}_3]$
  - $[\text{NF}_3, \text{H}_3\text{O}^+]$  and  $[\text{HN}_3, \text{BF}_3]$
- In the compound  $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{CH}_2 - \text{C} \equiv \text{CH}$ , the  $\text{C}_2 - \text{C}_3$  bond is of the type
  - $\text{sp} - \text{sp}^2$
  - $\text{sp}^3 - \text{sp}^3$
  - $\text{sp} - \text{sp}^3$
  - $\text{sp}^2 - \text{sp}^3$
- The correct order of increasing C – O bond length of  $\text{CO}$ ,  $\text{CO}_3^{2-}$ ,  $\text{CO}_2$  is
  - $\text{CO}_3^{2-} < \text{CO}_2 < \text{CO}$
  - $\text{CO}_2 < \text{CO}_3^{2-} < \text{CO}$
  - $\text{CO} < \text{CO}_3^{2-} < \text{CO}_2$
  - $\text{CO} < \text{CO}_2 < \text{CO}_3^{2-}$
- In the dichromate dianion
  - 4 Cr – O bonds are equivalent
  - 6 Cr – O bonds are equivalent
  - All Cr – O bonds are equivalent
  - All Cr – O bonds are non-equivalent
- Hybridisation state of chlorine in  $\text{ClF}_3$  is
  - $\text{sp}^3$
  - $\text{sp}^3\text{d}$
  - $\text{sp}^3\text{d}^2$
  - $\text{sp}^3\text{d}^3$
- In which of the following the central atom does not use  $\text{sp}^3$  hybrid orbitals in its bonding
  - $\text{BeF}_3^-$
  - $\text{OH}_3^+$
  - $\text{NH}_2^-$
  - $\text{NF}_3$
- The magnetic moment of  $\text{K}_3[\text{Fe}(\text{CN})_6]$  is found to be 1.7 B.M. How many unpaired electron (s) is/are present per molecule
  - 1
  - 2
  - 3
  - 4
- $\text{N}_2$  and  $\text{O}_2$  are converted into monocations  $\text{N}_2^+$  and  $\text{O}_2^+$  respectively. Which is wrong
  - In  $\text{N}_2$  the N – N bond weakens
  - In  $\text{O}_2$  the O – O bond order increases
  - In  $\text{O}_2$  paramagnetism decreases
  - $\text{N}_2^+$  becomes diamagnetic
- The common features among the species  $\text{CN}^-$ ,  $\text{CO}$  and  $\text{NO}^+$  are
  - Bond order three and isoelectronic
  - Bond order three and weak field ligands
  - Bond order two and  $\pi$ -acceptors
  - Isoelectronic and weak field ligands
- The number of S – S bonds in sulphur trioxide trimer  $\text{S}_3\text{O}_9$  is
  - Three
  - Two
  - One
  - Zero
- Select the most ionic and most covalent compounds respectively from the following.  
 $\text{CrO}_5$ ,  $\text{Mn}_2\text{O}_7$ ,  $\text{PbO}$ ,  $\text{P}_4\text{O}_{10}$ ,  $\text{SnO}_2$ 
  - $\text{CrO}_5$ ,  $\text{Mn}_2\text{O}_7$
  - $\text{Mn}_2\text{O}_7$ ,  $\text{PbO}$
  - $\text{CrO}_5$ ,  $\text{P}_4\text{O}_{10}$
  - $\text{CrO}_5$ ,  $\text{SnO}_2$
- In which of the following sets central atom of each member involves  $\text{sp}^3$  hybridisation ?
  - $\text{IO}_4^-$ ,  $\text{ICl}_4^-$ ,  $\text{IF}_4^+$
  - $\text{XeO}_3$ ,  $\text{XeO}_4$ ,  $\text{XeF}_4$
  - $\text{SO}_3$ ,  $\text{SO}_3^{2-}$ ,  $\text{SO}_4^{2-}$
  - $\text{PCl}_4^+$ ,  $\text{BF}_4^-$ ,  $\text{ClO}_4^-$

# 11<sup>th</sup> Class Modules Chapter Details



PHYSICS	CHEMISTRY	BIOLOGY
<p><b>Module-1</b></p> <ol style="list-style-type: none"> <li>1. Physical World &amp; Measurements</li> <li>2. Basic Maths &amp; Vector</li> <li>3. Kinematics</li> </ol> <p><b>Module-2</b></p> <ol style="list-style-type: none"> <li>1. Law of Motion &amp; Friction</li> <li>2. Work, Energy &amp; Power</li> </ol> <p><b>Module-3</b></p> <ol style="list-style-type: none"> <li>1. Motion of system of particles &amp; Rigid Body</li> <li>2. Gravitation</li> </ol> <p><b>Module-4</b></p> <ol style="list-style-type: none"> <li>1. Mechanical Properties of Matter</li> <li>2. Thermal Properties of Matter</li> </ol> <p><b>Module-5</b></p> <ol style="list-style-type: none"> <li>1. Oscillations</li> <li>2. Waves</li> </ol>	<p><b>Module-1(PC)</b></p> <ol style="list-style-type: none"> <li>1. Some Basic Concepts of Chemistry</li> <li>2. Atomic Structure</li> <li>3. Chemical Equilibrium</li> <li>4. Ionic Equilibrium</li> </ol> <p><b>Module-2(PC)</b></p> <ol style="list-style-type: none"> <li>1. Thermodynamics &amp; Thermochemistry</li> <li>2. Redox Reaction</li> <li>3. States Of Matter (Gaseous &amp; Liquid)</li> </ol> <p><b>Module-3(IC)</b></p> <ol style="list-style-type: none"> <li>1. Periodic Table</li> <li>2. Chemical Bonding</li> <li>3. Hydrogen &amp; Its Compounds</li> <li>4. S-Block</li> </ol> <p><b>Module-4(OC)</b></p> <ol style="list-style-type: none"> <li>1. Nomenclature of Organic Compounds</li> <li>2. Isomerism</li> <li>3. General Organic Chemistry</li> </ol> <p><b>Module-5(OC)</b></p> <ol style="list-style-type: none"> <li>1. Reaction Mechanism</li> <li>2. Hydrocarbon</li> <li>3. Aromatic Hydrocarbon</li> <li>4. Environmental Chemistry &amp; Analysis Of Organic Compounds</li> </ol>	<p><b>Module-1</b></p> <ol style="list-style-type: none"> <li>1. Diversity in the Living World</li> <li>2. Plant Kingdom</li> <li>3. Animal Kingdom</li> </ol> <p><b>Module-2</b></p> <ol style="list-style-type: none"> <li>1. Morphology in Flowering Plants</li> <li>2. Anatomy of Flowering Plants</li> <li>3. Structural Organization in Animals</li> </ol> <p><b>Module-3</b></p> <ol style="list-style-type: none"> <li>1. Cell: The Unit of Life</li> <li>2. Biomolecules</li> <li>3. Cell Cycle &amp; Cell Division</li> <li>4. Transport in Plants</li> <li>5. Mineral Nutrition</li> </ol> <p><b>Module-4</b></p> <ol style="list-style-type: none"> <li>1. Photosynthesis in Higher Plants</li> <li>2. Respiration in Plants</li> <li>3. Plant Growth and Development</li> <li>4. Digestion &amp; Absorption</li> <li>5. Breathing &amp; Exchange of Gases</li> </ol> <p><b>Module-5</b></p> <ol style="list-style-type: none"> <li>1. Body Fluids &amp; Its Circulation</li> <li>2. Excretory Products &amp; Their Elimination</li> <li>3. Locomotion &amp; Its Movement</li> <li>4. Neural Control &amp; Coordination</li> <li>5. Chemical Coordination and Integration</li> </ol>

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# 12<sup>th</sup> Class Modules Chapter Details

Physics  
5  
Modules

Chemistry  
5  
Modules

Mathematics  
5  
Modules

PHYSICS	CHEMISTRY	BIOLOGY
<p><b>Module-1</b></p> <ol style="list-style-type: none"> <li>1. Electrostatics</li> <li>2. Capacitance</li> </ol> <p><b>Module-2</b></p> <ol style="list-style-type: none"> <li>1. Current Electricity</li> <li>2. Magnetic Effect of Current and Magnetism</li> </ol> <p><b>Module-3</b></p> <ol style="list-style-type: none"> <li>1. Electromagnetic Induction</li> <li>2. Alternating Current</li> </ol> <p><b>Module-4</b></p> <ol style="list-style-type: none"> <li>1. Geometrical Optics</li> <li>2. Wave Optics</li> </ol> <p><b>Module-5</b></p> <ol style="list-style-type: none"> <li>1. Modern Physics</li> <li>2. Nuclear Physics</li> <li>3. Solids &amp; Semiconductor Devices</li> <li>4. Electromagnetic Waves</li> </ol>	<p><b>Module-1(PC)</b></p> <ol style="list-style-type: none"> <li>1. Solid State</li> <li>2. Chemical Kinetics</li> <li>3. Solutions and Colligative Properties</li> </ol> <p><b>Module-2(PC)</b></p> <ol style="list-style-type: none"> <li>1. Electrochemistry</li> <li>2. Surface Chemistry</li> </ol> <p><b>Module-3(IC)</b></p> <ol style="list-style-type: none"> <li>1. P-Block Elements</li> <li>2. Transition Elements (d &amp; f block)</li> <li>3. Co-ordination Compound</li> <li>4. Metallurgy</li> </ol> <p><b>Module-4(OC)</b></p> <ol style="list-style-type: none"> <li>1. HaloAlkanes &amp; HaloArenes</li> <li>2. Alcohol, Phenol &amp; Ether</li> <li>3. Aldehyde, Ketone &amp; Carboxylic Acid</li> </ol> <p><b>Module-5(OC)</b></p> <ol style="list-style-type: none"> <li>1. Nitrogen &amp; Its Derivatives</li> <li>2. Biomolecules &amp; Polymers</li> <li>3. Chemistry in Everyday Life</li> </ol>	<p><b>Module-1</b></p> <ol style="list-style-type: none"> <li>1. Reproduction in Organisms</li> <li>2. Sexual Reproduction in Flowering Plants</li> <li>3. Human Reproduction</li> <li>4. Reproductive Health</li> </ol> <p><b>Module-2</b></p> <ol style="list-style-type: none"> <li>1. Principles of Inheritance and Variation</li> <li>2. Molecular Basis of Inheritance</li> <li>3. Evolution</li> </ol> <p><b>Module-3</b></p> <ol style="list-style-type: none"> <li>1. Human Health and Disease</li> <li>2. Strategies for Enhancement in Food Production</li> <li>3. Microbes in Human Welfare</li> </ol> <p><b>Module-4</b></p> <ol style="list-style-type: none"> <li>1. Biotechnology: Principles and Processes</li> <li>2. Biotechnology and Its Applications</li> <li>3. Organisms and Populations</li> </ol> <p><b>Module-5</b></p> <ol style="list-style-type: none"> <li>1. Ecosystem</li> <li>2. Biodiversity and Conservation</li> <li>3. Environmental Issues</li> </ol>

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