NEET'25

CHEMISTRY

CHEMICAL BONDING AND MOLECULAR STRUCTURE

മലയാളത്തിൽ

PART 2

SAT | 9:00 PM LIVE

Plus One

PRITHVI

FOR NEET/KEEM ENTRANCE EXAM

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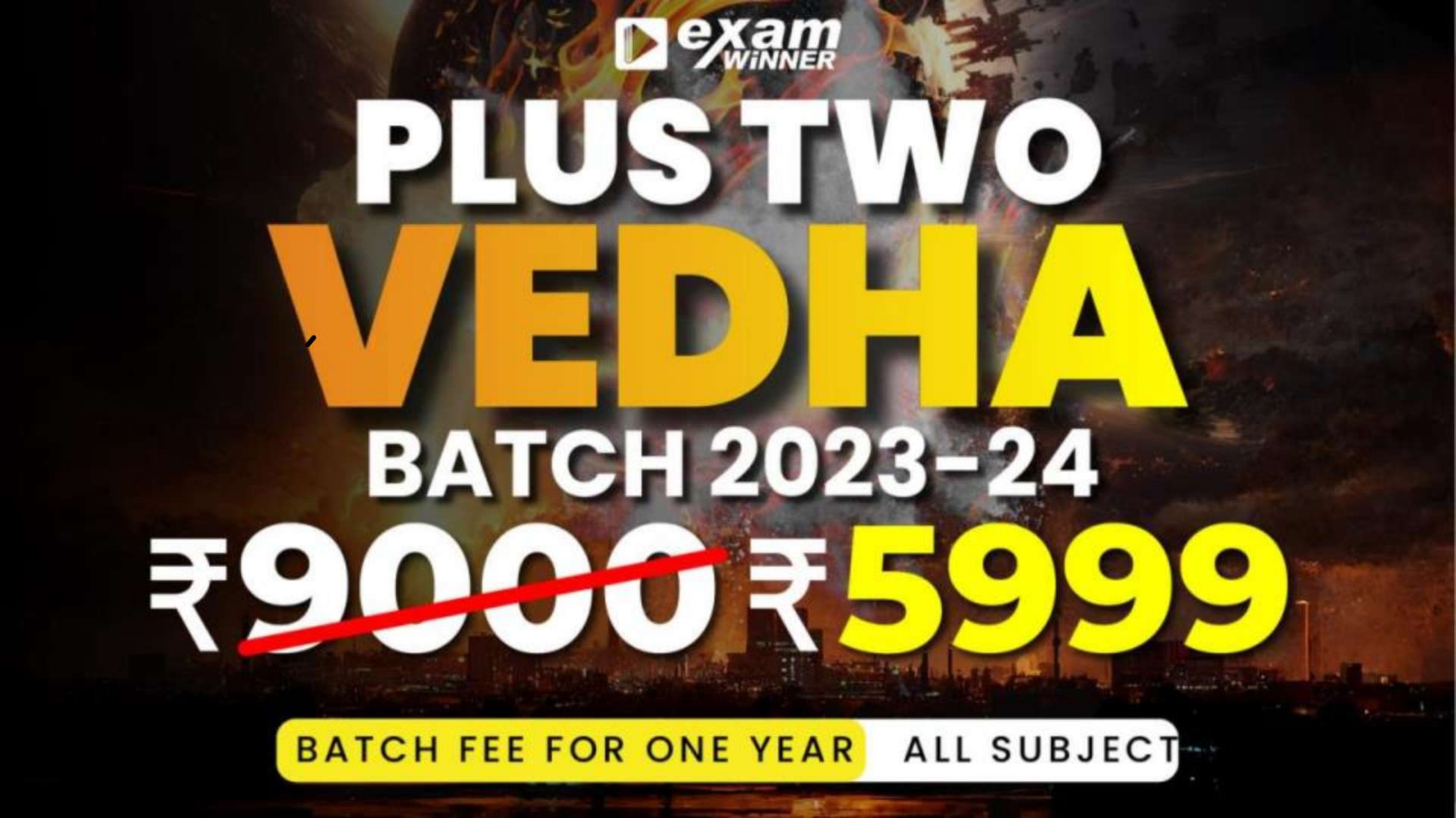
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WHATSAPP HI TO

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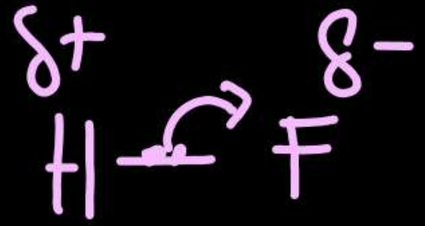
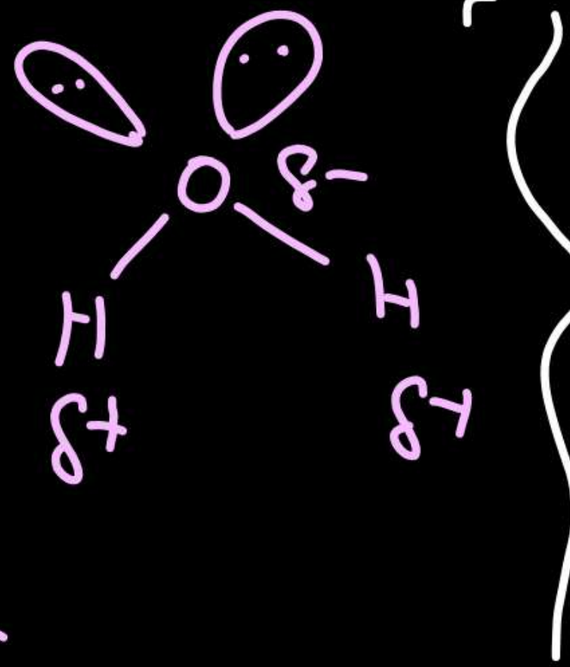
Partial Ionic Character of Covalent Bond



} Nonpolar molecules.



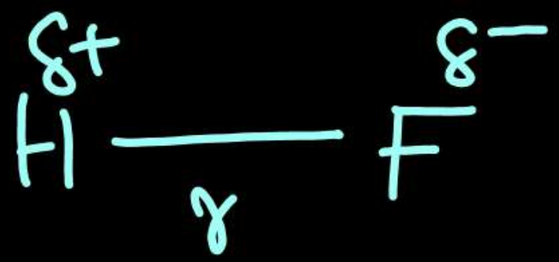
Covalent molecules with partial charges

=> Polar molecules

D

No bond is 100% ionic or
100% covalent

Dipole Moment



dipole

Dipde moment (M) = $Q \times r$.

$Q \rightarrow$ Magnitude of charge.

$Q \Rightarrow 4.8 \times 10^{-10}$ esu. or 1.6×10^{-19} C

$r \rightarrow$ distance

Unit: Debye (D), esucm, Cm.

It is a vector quantity

1 debye $= 3.335 \times 10^{-30}$ Cm

$= 1 \times 10^{-18}$ esucm.

Applications of Dipole moment

1. Predicting the polarity of bonds

μ value $\propto$ polarity of bond.

$H-F > H-Cl > H-Br > H-I$

1.98 D 1.03 D 0.78 D 0.38 D

electronegativity difference $\propto$ dipole moment.

$CH_3F < CH_3Cl$

distance factor dominates

$\uparrow \mu = \alpha \times r$

Applications of Dipole moment

2. Predicting the symmetry of molecules

Symmetrical molecules

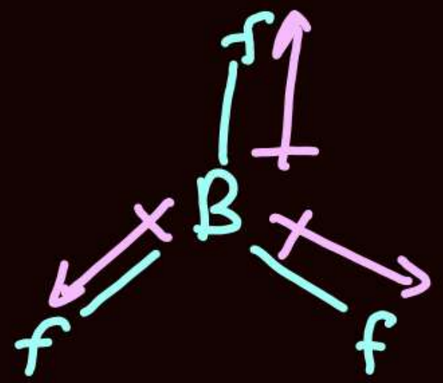
CO_2 :→ O=C=O

Bond dipole moments cancel out each other $\mu = 0$.

$BeCl_2$: Cl—Be—Cl

$\mu = 0$.

$BF_3 \rightarrow$



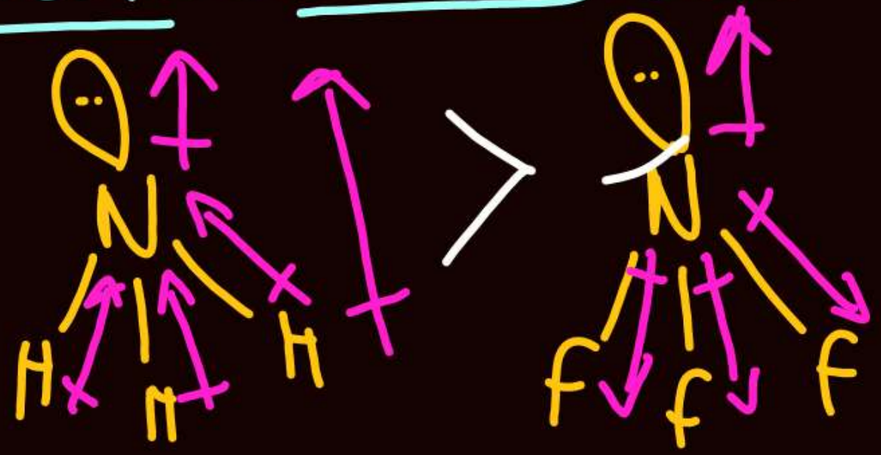
$\mu = 0$.

CH_4, PCl_5, SF_6 ---- $\mu = 0$.

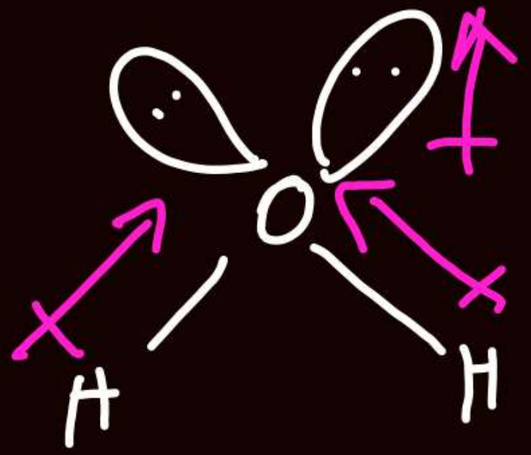
} Nonpolar molecules.

✱ Unsymmetrical molecules.

NH_3 :



$\mu \neq 0$



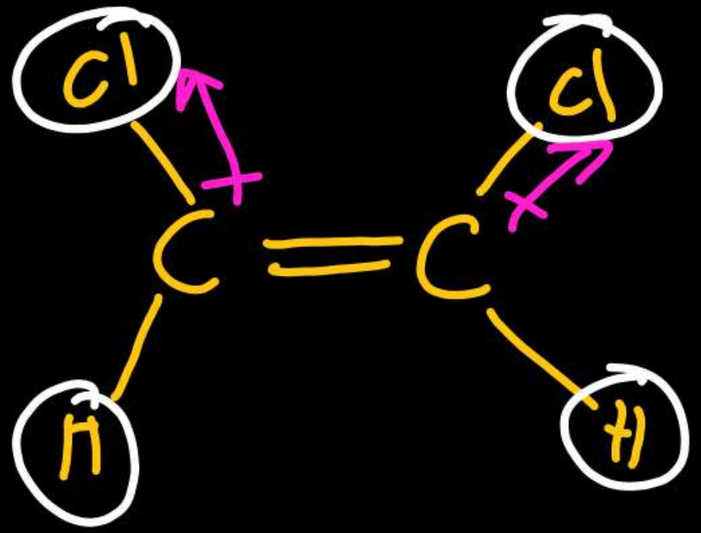
$\mu \neq 0$ } Polar molecules.

$\mu = 0 \Rightarrow$ Nonpolar molecule : $CO_2, BF_3, BeCl_2, XeF_4$
CH_4, PCl_5, SF_6.

$\mu \neq 0 \Rightarrow$ Polar molecule $\rightarrow H_2O, NH_3, NF_3$

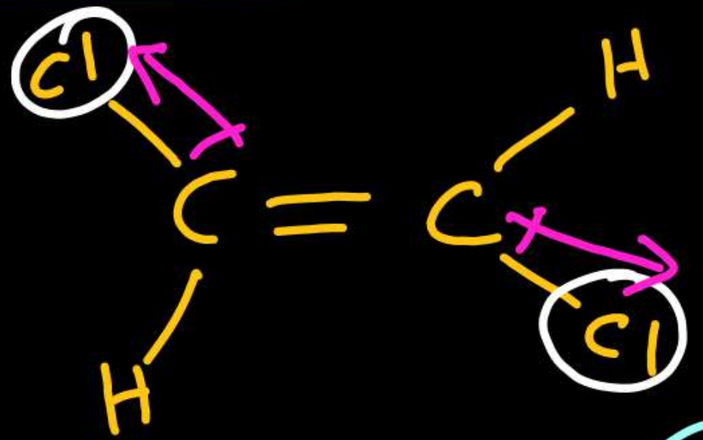
Applications of Dipole moment

3. In distinguishing between cis and trans isomers



Cis isomer

$\mu \neq 0$ } Polar

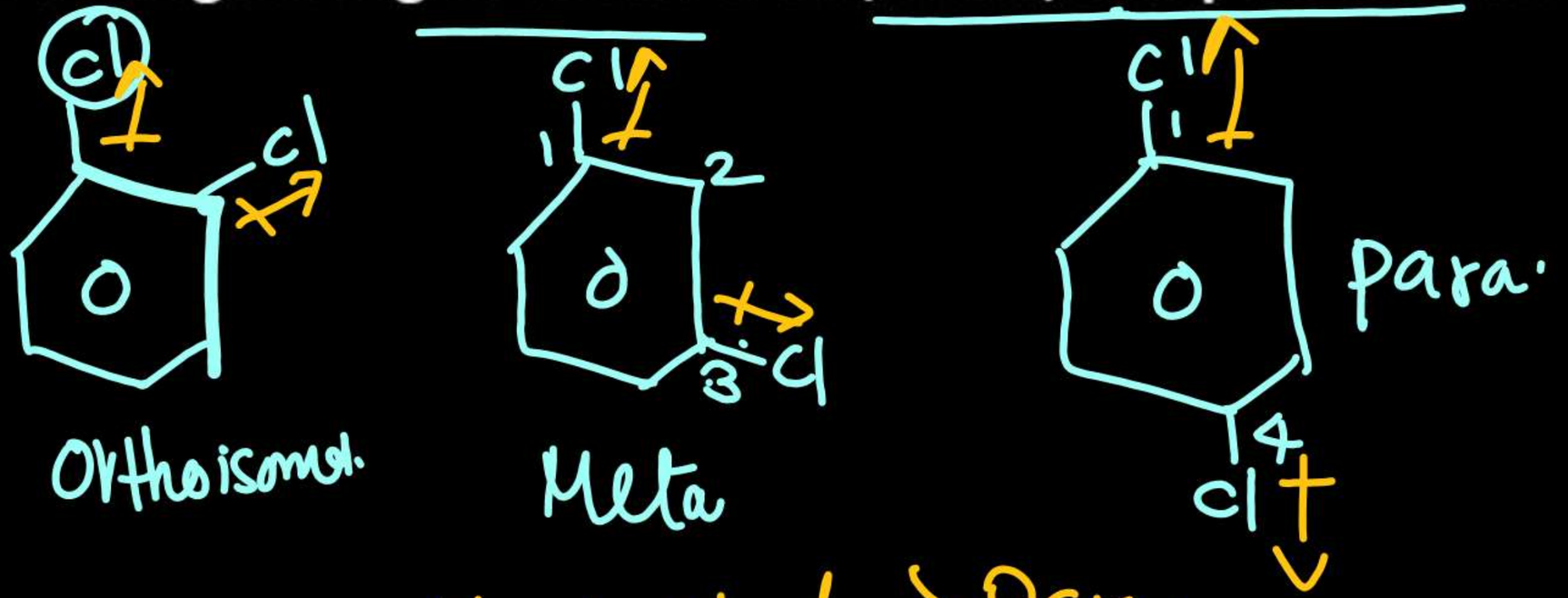


Trans isomer

$\mu = 0$ } Non polar.

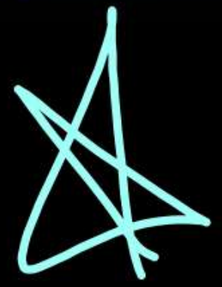
Applications of Dipole moment

4. In distinguishing between ortho, meta, and para isomers



Ortho > Meta > Para.

PERCENTAGE IONIC CHARACTER



$$\% \text{ ionic character} = \frac{\mu_{observed}}{\mu_{ionic}} \times 100$$

$\mu_{observed}$:→ experimental (Cm)

· μ_{ionic} (theoretical) ⟹ $\mu = q \times r$

D·M

1 debye $= 10^{-18}$ esucm.

A diatomic molecule has a dipole moment 1.2D and its bond length is 1 A°. Its % ionic character is

$\mu_{observed} = 1.2D.$

$r = 1\,\text{Å} = 10^{-8}\,cm.$

$\mu_{theoretical} = q \times r = 4.8 \times 10^{-10}\,esu \times 10^{-8}\,cm$

$= 4.8 \times 10^{-18}\,esucm$

$= 4.8\,D$

$\%\ \text{ionic chr} = \frac{\mu_{observed}}{\mu_T} \times 100$

$= \frac{1.2}{4.8} \times 100 = 25\%$

An example of non-polar molecule is

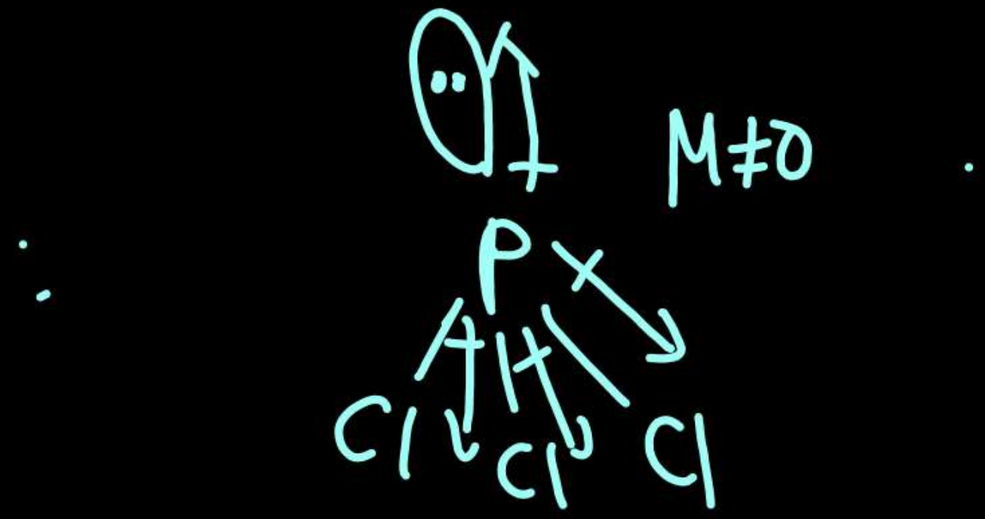
(1) BF_3

(2) ClF_3

(3) PCl_3

(4) SO_2

$\mu = 0$.



∴

Symmetrical : Planar.

BF_3 → nonpolar

NF_3 → polar

↓

Unsymmetrical : Pyramidal.

The molecules BF_3 and NF_3 are both covalent compounds, but BF_3 is non-polar where as NF_3 is polar. The reason for this is

(1) B is a metal while nitrogen is a gas in uncombined state

(2) B-F bonds are non-polar while N-F bonds are polar

(3) BF_3 is planar but NF_3 is pyramidal

(4) Atomic size of boron is larger than that of Nitrogen

1 Debye is equal to

(1) 10^{-18} e.s.u. cm

(2) 10^{-10} e.s.u. cm

(3) 10^{-12} e.s.u. cm

(4) 10^{-15} e.s.u. cm

nonpolar.

Dipole moment is zero for which of the following pair of molecules?

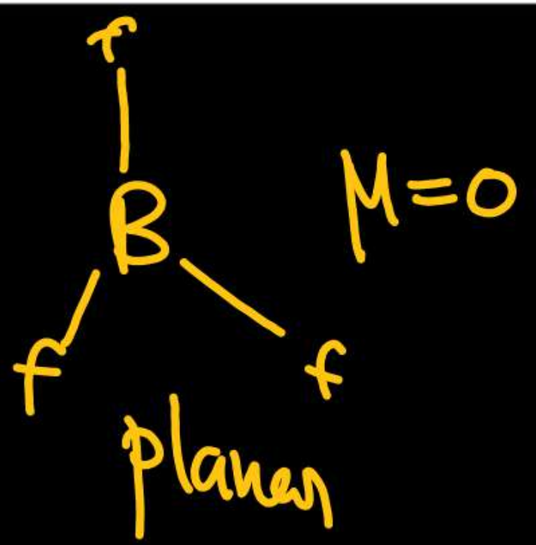
(1) BF_3, SO_2

(2) BF_3, CCl_4

(3) SO_2, $CHCl_3$

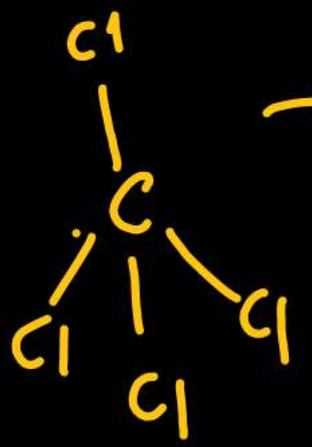
(4) CCl_4, SO_2

$\mu = 0$ nonpolar.



Planar

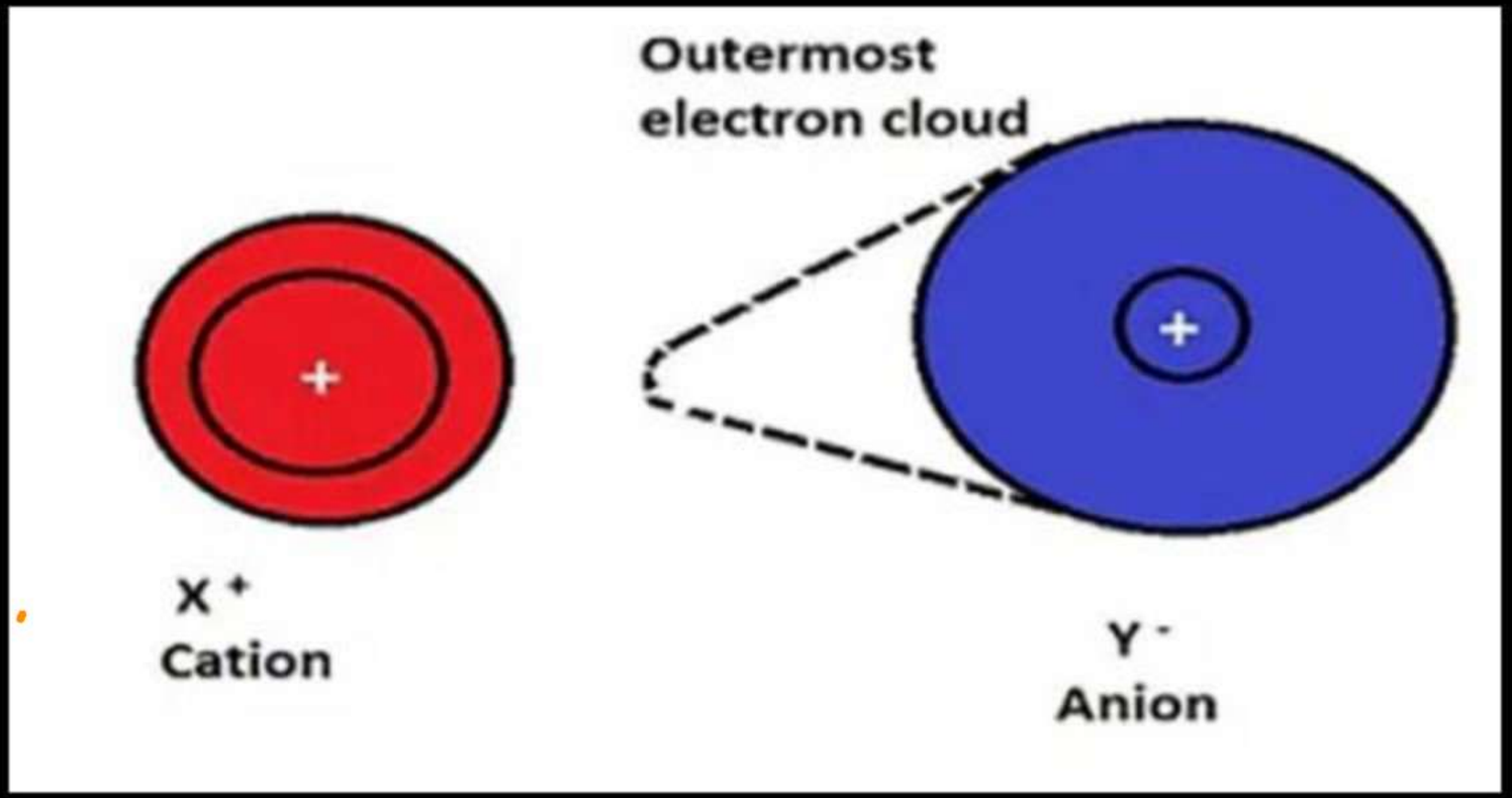
$\mu = 0$

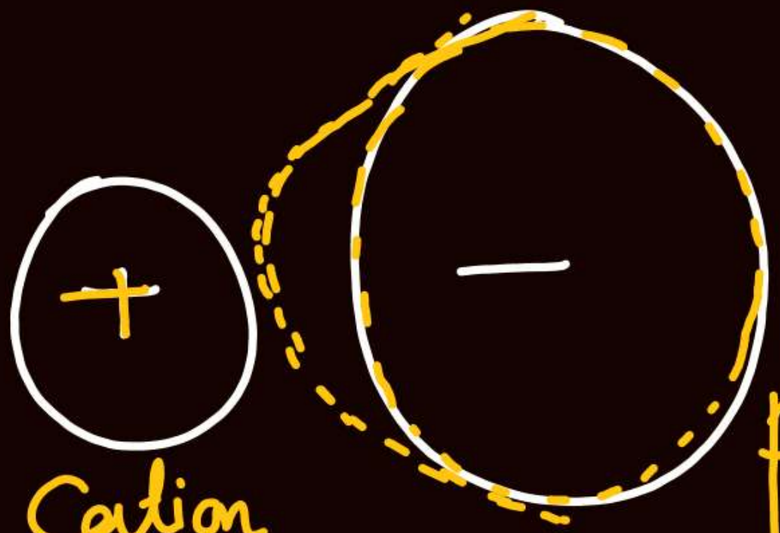


Tetrahedral

$\mu = 0$

Partial Covalent Character Of ionic Bond
(Fajans Rule)





Cation
Polarising power
of cation

Polarisibility
of anion

greater polarising power of cation, greater polarisibility of anion greater is the covalent nature of ionic bond

1) polarising power of cation $\propto$ charge of cation

$\propto \frac{1}{\text{size of cation}}$

2) polarisibility of anion $\propto$ charge of anion

$\propto$ size of anion

Fajans Rule

- Its about covalent nature of ionic bond
- Greater the polarising power of the cation and grater polarizibility of anion greater is the covalent character of ionic bond
- The ability of a cation to distort an anion is known as its polarization power and the tendency of the anion to become polarized by the cation is known as its polarizability

Fajans Rule

CuCl / NaCl

d block.

Covalent nature

- α Charge on ions
- α Size of anion
- $\alpha \frac{1}{\text{Size of cation}}$

When cations are from transition metals ,then greater covalent character

d block.

The compound possessing maximum covalent character among the following is

[NCERT Pg. 112]

(1) LiCl

(2) NaCl

(3) CsCl

(4) KCl

Percentage covalent character is higher in

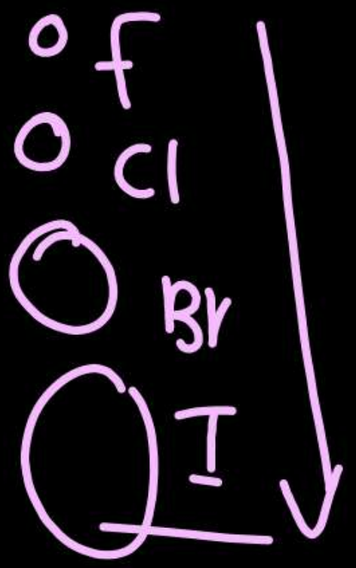
(1) NaF

(2) NaCl

(3) NaBr

(4) NaI

Covalent nature $\propto$ size of anion



Polarisation is the distortion of the shape of an anion by an adjacently placed cation. Which of the following statements is correct?

(1) Maximum polarisation is brought about by a cation of high charge

(2) Minimum polarisation is brought about by a cation of low radius

(3) A large cation is likely to bring about a large degree of polarisation

(4) A small anion is likely to undergo a large degree of polarisation

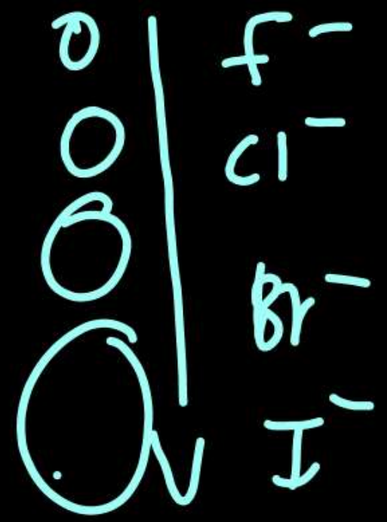
The anion having highest polarizability is

(1) F^-

(2) Cl^-

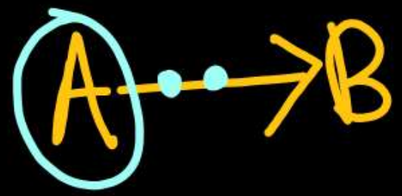
(3) Br^-

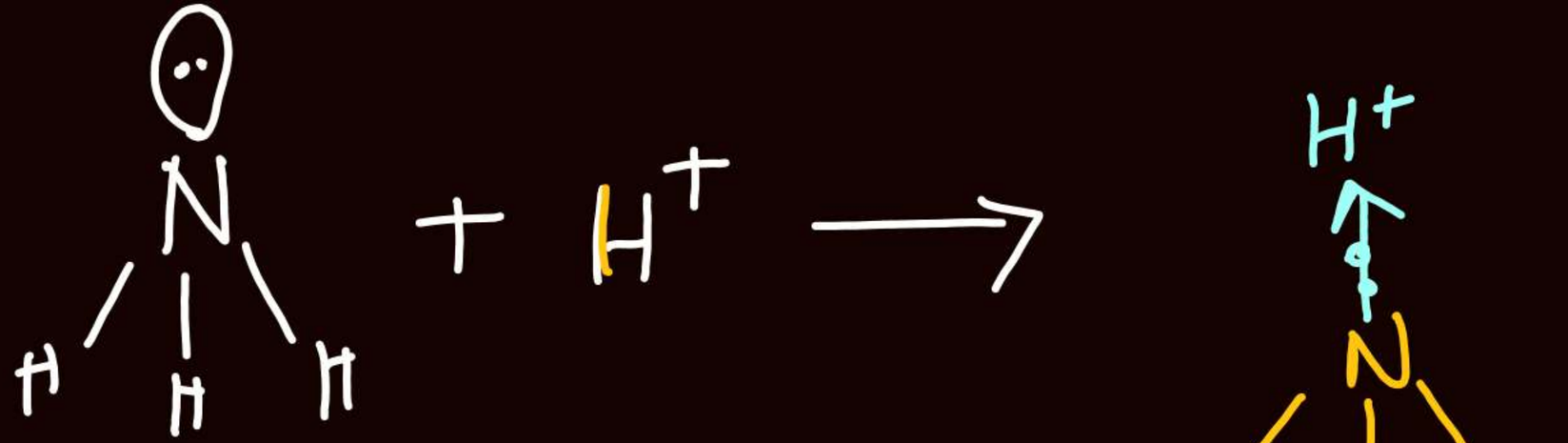
(4) I^-



Coordinate Bond Or Dative Bond Or Semi polar bond

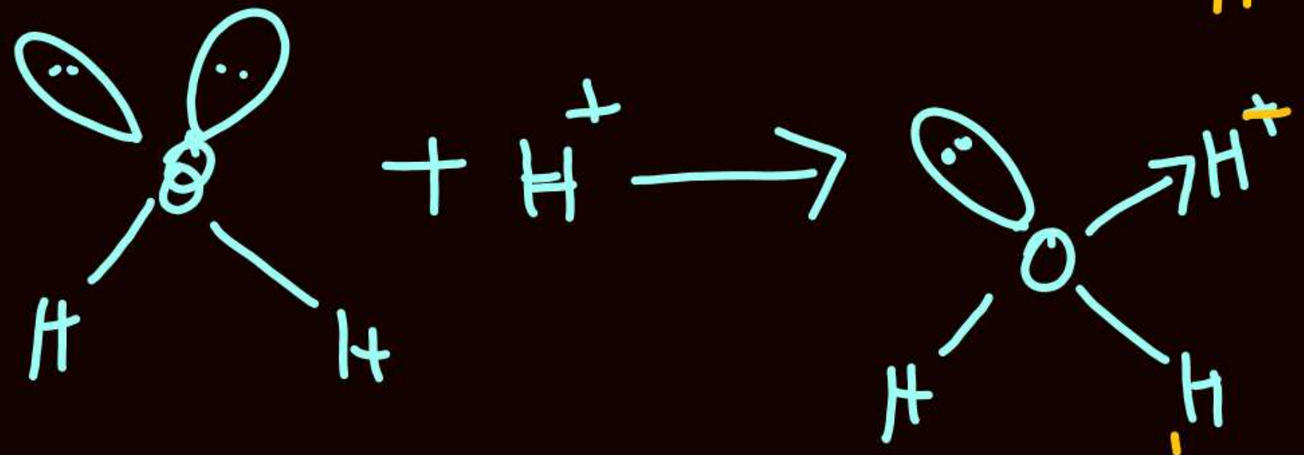
The bond formed between two atoms in which contribution of electron pair is made by one atom is called co ordinate bond





NH_4^+

3 covalent bond
1 coordinate bond



H_3O^+
hydronium ion
2 covalent bond
1 coordinate bond

What type of bonds are present in NH_4Cl?

$NH_4Cl \rightarrow NH_4^+ \; Cl^-$

1) Ionic bond
2) Coordinate bond
3) Covalent bond

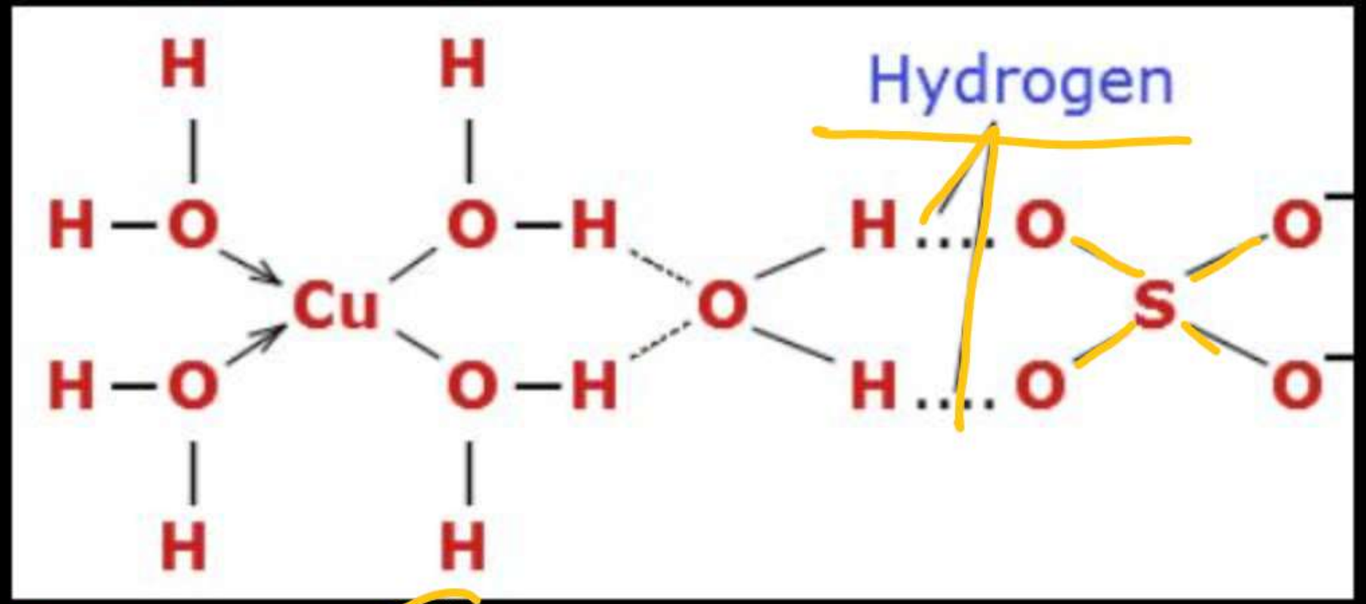
$K_4[Fe(CN)_6] \longrightarrow 4K^+ + [Fe(CN)_6]^{4-}$

Complex

1) Ionic bond.
2) coordinate bond
3) covalent bond

$CuSO_4.5H_2O$

1) Ionic bond ✓
2) Coordinate bond ✓
3) Hydrogen bond ✓
4) Covalent bond ✓



$[Cu(H_2O)_4]^{2+} H_2O \cdot SO_4^{2-}$

Metal → Ligand

VSEPR