Dr. L. K. Mishra
Deptt of Chemistry

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Date

Deg III Chem. Hons, Paper- V

Topic :- Physical Properties and Chemical Constitution

Polar molecule :- HF, HCl and CO molecules are Polar due to differate in electronegativity of two atoms.

$H^{+\delta}-F^{-\delta}$, $H^{+\delta}-Cl^{-\delta}$ $\quad :C^{+\delta}\equiv O^{-\delta}:$

They have Permanent dipole

HF is more Polar than HCl

Dipole moment :-

The degree of Polarity of a molecule is expressed in terms of Dipole moment which is defined as the Product of the magnitude of one of the charges and the distance between them ie the bond Length.

If Z is the charge at each end of the molecule and l is the distance between the charges, the Permanent dipole moment, μ is given by $\mu = Z \cdot l$

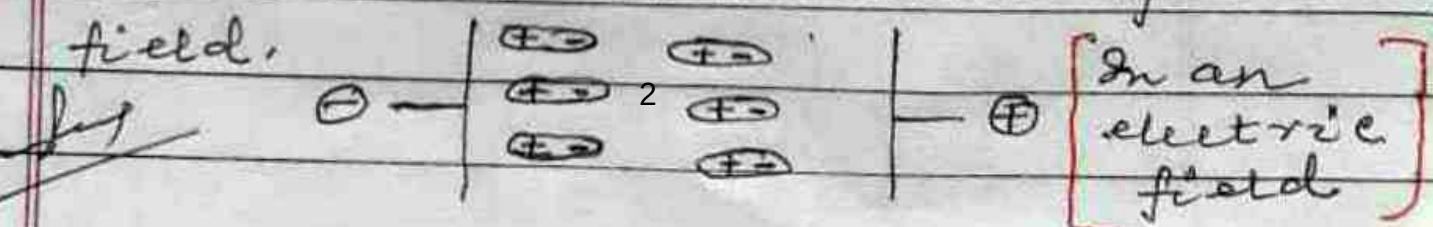
Since the electronic charges is of the order of 10^{-10} e.s. unit and molecular diameters are of the

order of 10^{-8} cm. The value of dipole moment of the molecule will be of the order of $10^{-10} \times 10^{-8} = 10^{-18}$, This quantity is called Debye Unit and is denoted by the Symbol D, For example, dipole moment of HCl is 1.03×10^{-18} and is written as 1.03 D.

	Debye unit		Debye unit
H_2, Cl_2, N_2, Br_2	0	CO	1.12
HF	1.92	NH_3	1.46
HCl	1.03	C_2H_4, CH_4, C_2H_6	0
HBr	0.78	CH_3Cl	1.86
HI	0.38	C_2H_5Cl	2.04
H_2O	1.84	C_2H_5Br	2.0
H_2S	0.92	C_2H_5OH	1.65
SO_2	1.60	CH_3COOH	1.40

Effect of Electric field :-

The Permanent dipoles ordinarily are oriented in a random manner. But, when Placed in an electric field the molecule rotate and orient themselves in the direction of electric field.



Measurement of Dipole moment :—

When a permanent dipole moment is present in a molecule, the molar Polarisation P is given by

$$P = P_i + P_o \quad \text{——— (1)}$$

Where P_i = Induced molar Polarisation

P_O = Molar orientation Polarisation

Debye showed that

$$P_o = \frac{4}{3}\pi N(\mu^2/3KT) \quad \text{— (2)}$$

where μ is Permanent dipole moment of molecule, K is the gas constant per molecule ($K = R/N$) and T is the absolute temperature

Substituting the value of P_i and P_o in equation (1) we get

Total molar polarisation (P)

$$P = \frac{4}{3}\pi N\alpha + \frac{4}{3}\pi N(\mu^2/3KT) \quad \text{— (3)}$$

the first term is constant and the second term on the right hand side also include Constant quantities except T

Hence P maybe Put as

$$P = A + \frac{B}{T} \quad \text{——— (4)}$$