

Deg III Chem. Hons, Paper - V

Topic:- Physical Properties and  
Chemical Constitution

Measurement of Dipole moment (Rest)

In the case of polar molecules i.e. molecules with permanent dipoles, the graph between Total molar Polarisation and  $\frac{1}{T}$  should be a straight line and that the slope of the line should be given by

$$B = \frac{4\pi N \mu^2}{9K}$$

Thus by determining the slope of the line, the permanent dipole moment,  $\mu$  can easily be evaluated since  $N$  and  $K$  are known.

Substituting the value of  $N$  and  $K$  in the above expression

$$\mu = 0.0128 \sqrt{B} \times 10^{-18}$$

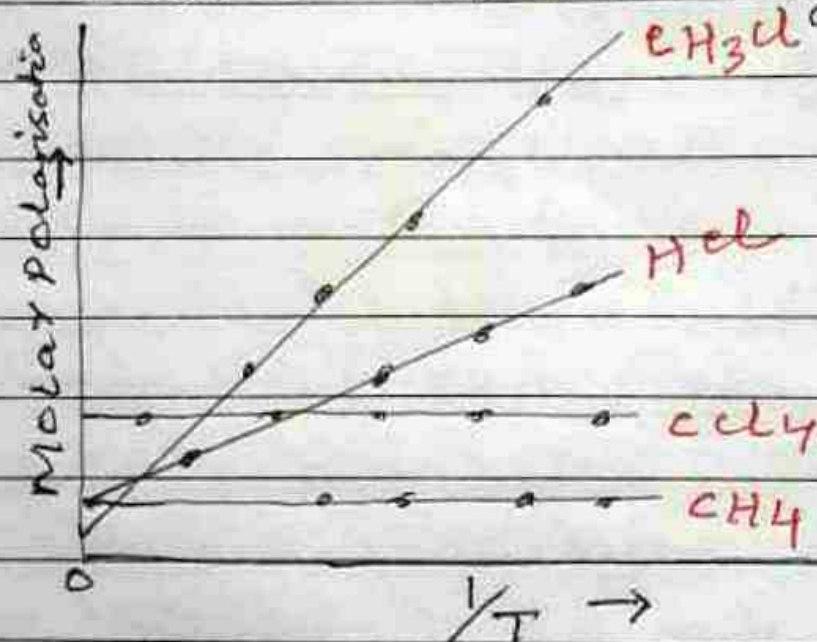
Molecules with permanent dipoles are called polar molecules.

Such as HF, HCl, H<sub>2</sub>O and CH<sub>3</sub>Cl

~~infy~~  
According to Debye theory, the total molar Polarisation



in the case of molecules with permanent dipoles should vary linearly with  $\frac{1}{T}$  while that in the case of molecules without permanent dipoles should be independent of  $T$ . This graph for few molecules are plotted in the figure and are seen to be in good accord with the theory.



This theory is useful in determining whether a given molecule is polar or non-polar. All that has to be done is to measure the dielectric constant and density of the given substance at different temperature and calculate the value of  $P$  with the help of expression  $P = \frac{D-1}{D+2} \cdot \frac{M}{\rho}$



## Application of Dipole moment -

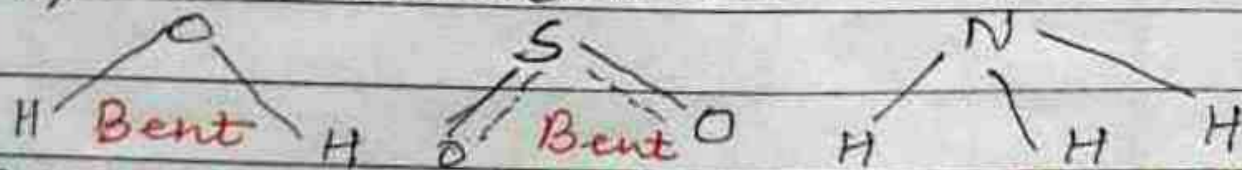
### (1) Polarity of bond :-

The value of Dipole moment indicates the Polar character of a bond.

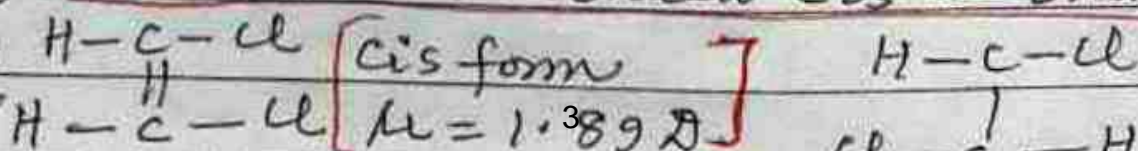
The dipole moment of HF and HCl are 1.92 D and 1.03 D. The value shows ~~are~~ that HF bond is more Polar than HCl bond. The dipole moment of CO is 0.12 D. This means that CO bonds are weakly Polar.

### (2) Shape of molecules :-

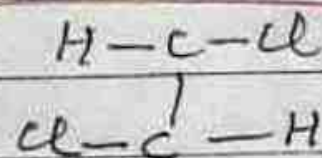
Water molecule has appreciable value of dipole moment (1.84 D). This indicates that H<sub>2</sub>O molecule is not linear and should have bent structure. SO<sub>2</sub> molecule has dipole moment (1.60 D) and possess bent structure. NH<sub>3</sub> molecule has dipole moment (1.46 D) having triangular Pyramidal structure.



### (3) Distinction between Cis and trans Isomers



1,2 dichloroethane



[Trans-form  $\mu = 0$ ]