Experiment No. .....

Page No. .....

Date : .....

Pure vibrational and vibrational-rotational spectra.

Vibration spectra is observed near infrared region. It is result of transition between vibrational energy levels.

Each vibrational transition is accompanied by a number of rotational transitions. Therefore spectra consists of a series of closely packed lines which appear as band.

The frequency absorbed during such transitions lie in the infrared region of the electromagnetic spectrum. Therefore it is called infrared spectroscopy.

This type of spectra is given by diatomic molecules with permanent dipole moments (i.e HCl CO etc) and polyatomic molecules (CO_2, CCl_4 etc). Vibrational rotational spectra are not exhibited by homodiatomic molecules (H_2, Cl_2 etc) because these have no permanent dipoles.

When the molecule having electric dipole is kept in the electric field (beam of IR radiation) this field exert forces on the electric charges in the molecule. Opposite charges

Teacher's Signature .....

Experiment No. .....

Page No. .....

Date : .....

will experience ~~in the opposite~~ directions. This tends to decrease or increase separation between bonded atoms. When these charged atoms vibrates, they absorbed IR radiation from the source. Intense band is the result of fast vibration while slow vibration gives weak bands in the IR-spectrum.

In case of non polar polyatomic molecules (CO_2) IR-spectra is obtained by some modes of vibrations causes change in the dipole moment.

Vibrational energy (Harmonic oscillator)

The vibrations of a diatomic molecule may be compared to those of simple harmonic oscillator in which the force tending to restore an atom to its original position. This is called Hooke's law. In other words, a covalent bond may be considered as a weightless spring. The restoration force F (acting upon it when it is stretching to a distance x is given by Hooke's law as

$$F = -kx$$

Teacher's Signature .....

SBPD PUBLICATIONS

Experiment No. .....

Page No. .....

Date : .....

where K is the force constant of the spring (bond). Negative sign indicates that F is a restoring force.

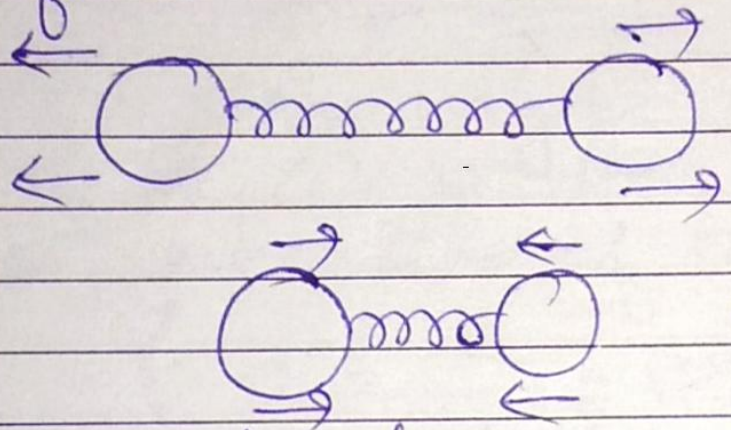

Fig. Vibratory motion of a diatomic molecule.