Diffraction of radiation: Electromagnetic radiation travels in straight line but when it is allowed to pass through edge it bends. The bending of radiation is called diffraction

Transmission of radiation: The stepwise process involving oscillating atoms ions or molecules as intermediate. The o interaction is alternating electrical field of radiation; it causes oscillation of electron. The polarised particle emit radiation in all direction

Dispersion: The ratio velocity of radiation of a particular frequency in vacuum to that in the medium. The variation of ~~x~~ refractive index of a substance with faquency or wavelength is called its dispersion

Refraction of radiation: when a beam of radiation is allowed to pass from one medium to another having a different physical density than first. This is due to difference in velocity of radiation between two media This is called refraction

$$\frac{\sin\theta_1}{\sin\theta_2} = \frac{n_2}{n_1} = \frac{V_1}{V_2}$$

Reflection of Radiation: when a beam of radiation is allowed to cross an interface between media of different refractive index

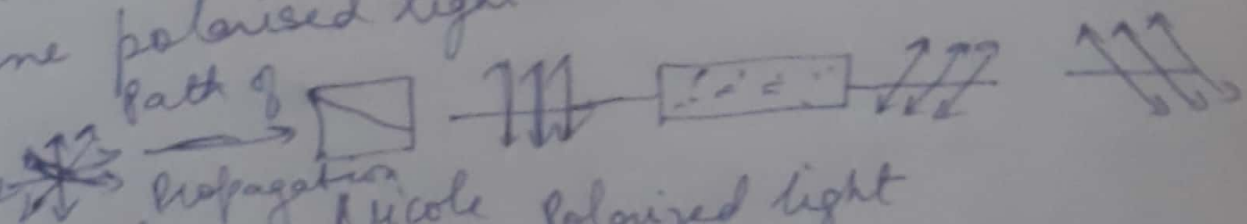
the fraction reflected increases with increasing differences in refractive index. If a beam is allowed to travel normal to the interface

$$\frac{I_R}{I_0} = \frac{(n_2 - n_1)^2}{(n_2 + n_1)^2}$$

I_0 = Intensity of incident radiation
I_R = Intensity of reflected radiation
n_1 and n_2 are refractive indices of two media

Scattering of Radiation: when a turbid Soln a suspension of solid particles in a liquid, is brought into the light path of a photometer less radiant power than light is scattered by the particle.

Polarisation of Light: If a ray of light travels in any direction it has vibrations in all direction at right angles to the path of propagation. If this light is passed through Nicol prism then the light which emerges out of the prism is found to have vibrations only in one plane. This light is called plane polarised light.



Natural line width and Natural line broadening including uncertainty Relation:

Selection rule: Atomic spectrum and molecular spectrum are obtained due to transition taking place between energy levels. Transition takes place between definite energy levels. The restriction thus applied on the transition are governed by certain rules called selection rule.

If rules are followed, the transition can take place and it is called an allowed transition. If rules are not followed, transition cannot take place and it is called forbidden transition.

Selection rule: They expressed in quantum number for the allowed transition.

For pure rotational transition, selection rule

$\Delta J = \pm 1$, J is rotational quantum number

$\Delta J = +1$ represents absorption and

$\Delta J = -1$ is emission.

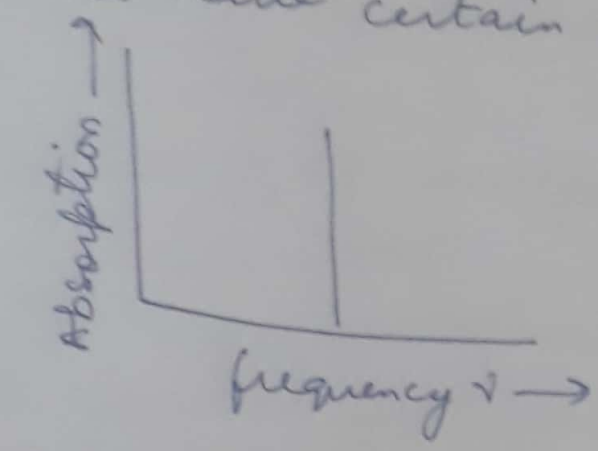
For pure vibrational transition, selection rule

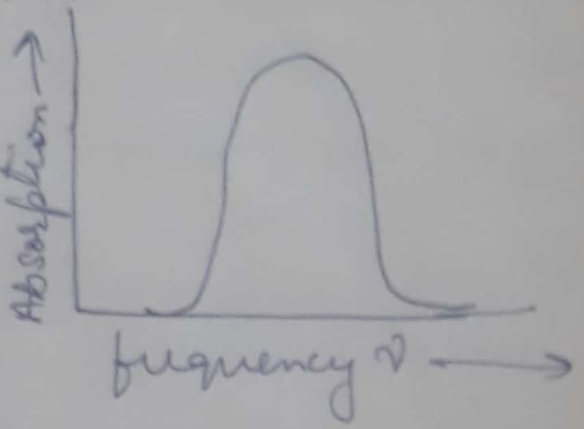
$\Delta v = \pm 1$, v is vibrational quantum number

width and intensities of the spectral lines:

width of spectral lines: when spectral line is sharp it will appear in the spectrum as vertical line it has no width. If line is not sharp it

will have certain width





Factors affecting width of spectral line

1) Doppler broadening 2) Lifetime broadening

Doppler broadening: Frequency of the radiation emitted or absorbed changes when the molecule is moving towards or away from observer.

2) Lifetime broadening:

$$\delta E = \frac{h}{2\pi\tau} \qquad \tau = \text{lifetime of the state}$$

Shorter the lifetime of the state involved in the transition, greater will be the broadening of the spectral line.

Intensity of spectral lines:

Factors affecting:

1) Population density of a state
2) Strength of the incident radiation
3) Probability of transition taking place between the energy level.

Greater the intensity of radiation, greater is the rate at which transition take place resulting stronger absorption

Degree of freedom: If a molecule made up of N atom There are three coordinate, to represent position of N mass point in space, we require 3N coordinates

The number of coordinates required to specify the position of all the mass point i.e atom in a molecule is called the number of degree of freedom

Hence molecule made of N atom have 3N degree of freedom. The number of coordinates required to specify the position of all the mass point i.e atom is called the number of degree of freedom.

Molecule of N atom have 3N degree of freedom

- Three translational degree of freedom (3N - 3)
- Three internal degree of freedom Subdivided into -

1) rotational degree of freedom
2) vibrational degree of freedom.

For rotational motion there are 2 degree of freedom for linear molecule and 3 degree of freedom for vibrational degree of freedom

for linear only at x axis or y axis
for non linear x axis y axis & z axis
for linear 3N-5) for non linear (3N-6)

For diatomic molecule CO (N=2) 3N-5

$3 \times 2 - 5 = 6 - 5 = 1$

For polyatomic linear molecule CO_2 N=3

$3 \times 3 - 5 = 9 - 5 = 4$

For non linear polyatomic molecule

H_2O N=3 3N-6

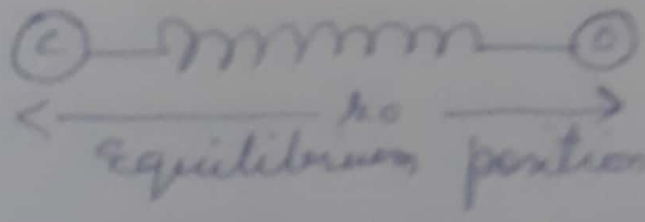
$3 \times 3 - 6 = 9 - 6 = 3$

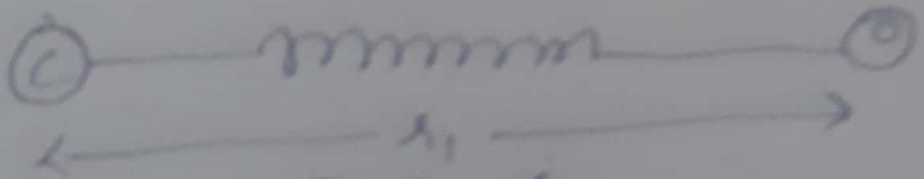
For benzene N=12 C_6H_6 3N-6

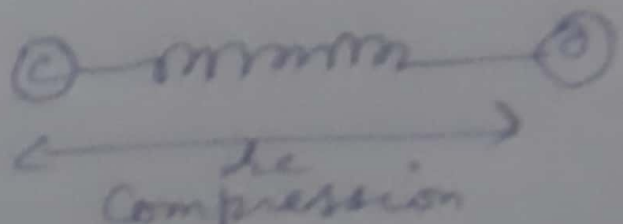
$3 \times 12 - 6 = 36 - 6 = 30$

For Vibrational degree of freedom they represent modes that occur in molecules depends upon the interatomic distances and angles needed to specify geometry

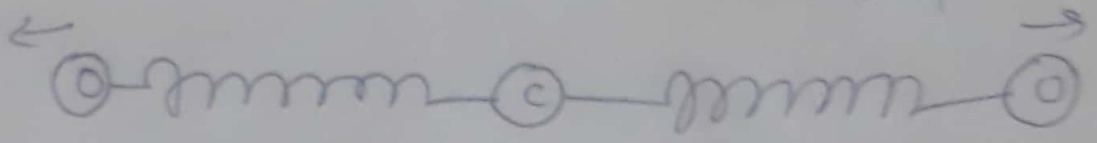
(for CO molecule 3N-5



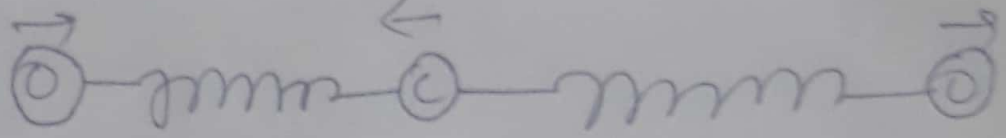




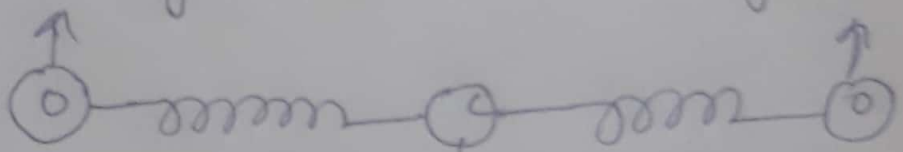
For CO_2 molecules $3n-2$
$= 4$



Symmetrical streching



Asymmetrical streching



Bending in the plane.

Bending out of plane.

For H_2O molecule.