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Page \_\_\_\_\_

## \* Difference bet<sup>n</sup> Raman & I.R Spectra

### Raman Spectra

1. It is observed due to scattering of light by vibrating molecules.

2. Polarizability of the molecule will <sup>decide</sup> whether ~~whether~~ the Raman Spectra will be observed or not.

3. Water can be used as a solvent.

4. Optical <sup>systems</sup> ~~sys~~ of the Spectrometer are made up of glass or quartz.

### I.R Spectra

1. It is result of absorption of light by vibrating molecules.

2. The presence of a permanent Dipole change moment ~~may be change~~ <sup>is the</sup> regarded as Criteria of I.R Spectra.

3. Water cannot be used because it is opaque to I.R radiation.

4. Optical <sup>systems</sup> ~~sys~~ of the Spectrometer are made up of special crystals. Such as  $\text{CaF}_2$ , NaBr etc.

5. In Raman effect vibrational frequencies of large molecules can be measured.

5. The vibrational frequencies of very large molecule cannot be measured.

6. Homonuclear diatomic molecules are Raman active i.e.  $N_2$ ,  $O_2$  etc show Raman spectra.

6. Homonuclear diatomic molecules are IR in-active i.e.  $N_2$ ,  $O_2$  do not show IR-spectra.

\* vibrational modes of  $CO_2$

$$\begin{aligned} \therefore \text{No. of modes of vibration} &= 3n - 5 \\ &= 3 \times 3 - 5 \\ &= 4 \end{aligned}$$

1)  $\leftarrow O - C - O \rightarrow$   
Symmetric stretching

Raman active but IR in-active

2)  $O \leftarrow C \rightarrow O$   
Asymmetric stretching

Raman inactive but IR active

3)  $\begin{array}{c} \uparrow \quad \quad \uparrow \\ O - C - O \\ \downarrow \end{array}$

Bending in plane

4)  $\begin{array}{c} \nearrow \quad \quad \nwarrow \\ O - C - O \\ \searrow \end{array}$

Bending out of plane

degenerate IR active

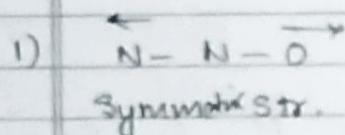


# \* Vibrational modes of $H_2O$

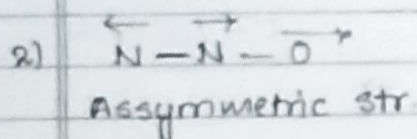
All three vibrational modes are Raman as well as IR-active.

# \* Vibrational modes of $N_2O$

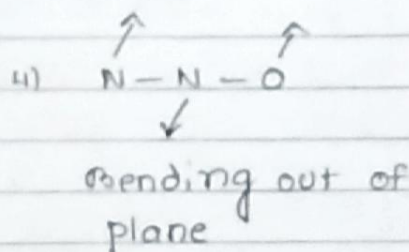
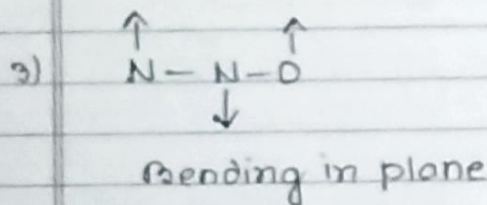
$$\begin{aligned} \text{No of Vib. modes} &= 3n - 5 \\ &= 3 \times 3 - 5 = 4 \text{ modes} \end{aligned}$$



Raman active  
IR active



IR & Raman active



Asymmetric Raman in-active IR active

As the two Raman lines appear in the I.R. of  $N_2O$  it means absence of centre of symmetry of molecule (If there is centre of symmetry only one Raman appear)