

Titration is qualitative analysis of a given compound by neutralizing its fixed equivalents with a known solution.

Types:-

1. Acid-Base Titration is known as neutralization, is of 2 types.

a. Acidimetry: Unknown amount of acid is known using standard alkali.

b. Alkalimetry: Unknown amount of base is known using standard acid.

2. Redox Titration.

3. Complexometric titration.

4. Precipitation Titration.

Titrant: Standard solution.

Titrand: Unknown solution.

Equivalence Point: no. of equivalence of Titrant is equal to no. of equivalence of titrand.

End Point: The point at which indicator gives visible change in Colour.

Standard solution i.e. Titrant is of 2 types.

I^o → which is 100% pure, neither

hygroscopic nor efflorescent.
 $\text{Fe}_2\text{O}_3 \rightarrow$ which has some impurities
 in it.

Ex. of $\text{I}^\circ \rightarrow \text{K}_2\text{Cr}_2\text{O}_7$, $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
 (Mohr's Salt), Oxalic acid, $\text{KHC}_8\text{H}_4\text{O}_4$
 (Potassium Hydrogen Tartrate)

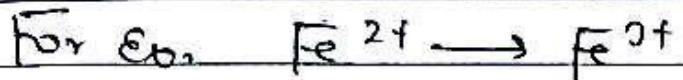
= Indicators : The chemical compounds
 that are used during rxn. and are
 used to show equivalence point or
 end point of rxn. are known as Indicator.

These are of 3 type :

i) Internal : Such indicator are added in
 beaker, e.g. Starch, methylorange,
 Phenolphthalein.

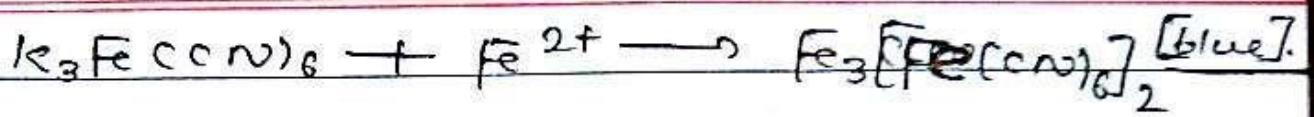
ii) External : Used from outside the
 apparatus.

iii) Self : Either titrant or titrand acts
 as indicator.



we take $\text{K}_3\text{Fe}(\text{CN})_6$ in a tile &
 add few drops of Fe^{2+} . On rxn,
 as far as Fe^{2+} remains, the solution
 will be blue & when finishes, the
 colour change occurs.

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2. Redox Titration:- It is a type of titration based on redox reaction between the analyte and titrant. The redox titration may involve the use of redox indicator.

Oxidation → Loss of e^- .

Reduction → Gain of e^- .

Oxidizing agent → Potassium Permagnate.
 → Potassium Iodide
 → Ceric ammonium Sulphate

Reducing agent → Oxalic acid
 → Sodium thiosulphate
 → Ferrous Ammonium Sulphate.
 → Titanium Sulphate

Indicator used in Redox Titration:

Indicator	Oxidized form	Color Change	Reduced form
Starch	Blue		Colourless
Diphenylamine	Violet		"
Diphenylbenzidine	Violet		"
Methylene Blue	Blue		"
Diphenylamine - Sulphonic acid	Red-violet		"

Dissolved Oxy. in water should be 40 to 120 ppm.

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Oxidizing agent gains & reduces to lower oxidation state.

whereas reducing agent loses electron and reduction occurs to higher oxi. state.

Oxidation & reduction occurs simultaneously and so called as Oxidation-Reduction Titration.

Applications of Redox titrations:-

- for determination of metals like Ca, Mg, Ni, Co, Fe.
- for determination of dissolved Oxygen, dissolved Cl, dissolved Hydrogen-peroxide & for dissolved anions NO_3^- , SO_4^{2-} , Cl^- , Br^- ,
- To determine oxidized state of element
- To determine Vitamin C.

Vitamin C is known as Ascorbic acid & is an powerful reducing agent. Its concentration can easily be identified when titrated with the blue dye (Dichlorophenolindophenol) which turns colourless when reduced by vit. C.

✓ → Benedict Reagent :-

Excess glucose in urine may indicate diabetes in patient. It is the conventional method to quantify glucose in urine using a prepared reagent. In this titration, glucose reduces cupric ions to cuprous ions, which reacts with potassium thiocyanide to produce a white ppt. indicating the end point.

→ Bromine Number :-

A measure of unsaturation in an analyte expressed in milligrams of bromine absorbed by 100 gms of Sample.

→ Iodine Number :-

A measure of unsaturation in an analyte expressed in milligrams of Iodine absorbed by 100 gms of Sample.

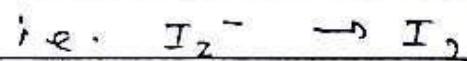
Iodometry

Iodoometry

Iodine as mild oxidizing agent & is used in volumetric titration. Iodine act as an oxidizing agent in neutral aqueous medium.



On the other hand, ~~Q~~A can oxidize I_2^- to I_2 .



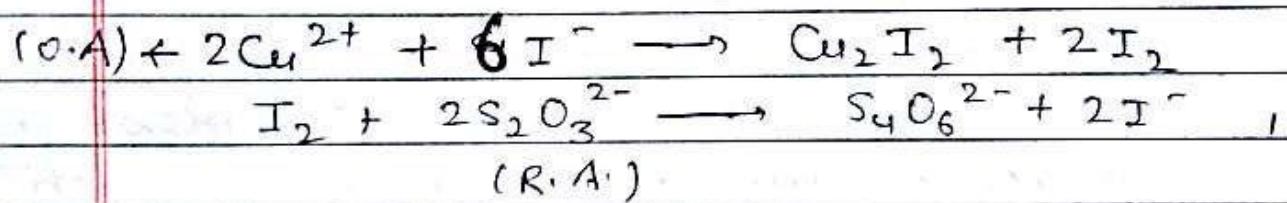
Both these rns. are used in Iodometry.

~~/~~ Iodine Titration; Iodometry:-

All such titration which involves the direct titration of iodine with a reducing agent are under Iodometry Titration. It is employed to determine the strength of reducing agent such as Sodium-thiosulphate, sulphite, stannous arsenite in neutral or acidic solutions. (Ferrous ions also).

Iodometry Titration :-

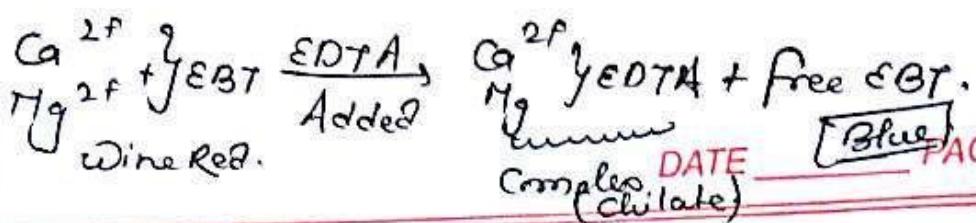
In this Titration, Iodine is liberated as a result of chemical reaction involving oxidation of an iodide ion by strong O.A. in neutral or acidic medium. The liberated Iodine is then titrated ~~with~~ with R.A. It is used to estimate the strength of oxidizing agent.



Imp. 3. Complexometric Titration:- (Chilometric)

In this titration, metal ion accepts electron and species donates electrons which are called as Tegana. Commonly used Tegana in Complexometric Titration is EDTA (Ethylene Diamine Tetra Acetic Acid) or Disodium Salt of EDTA.

Indicator used is called as Metal indicator which gives one colour in presence of metal ion & different colour in absence of m.i.



Examples of m.i. indicator :-

- i. Solochrome Black-T.
- ii. Thiovan Black-T.
- iii. Variamine Blue.
- iv. Murexide
- v. Eriochrome Black-T
- vi. Eriochrome Red-B
- vii. Sulphone Black

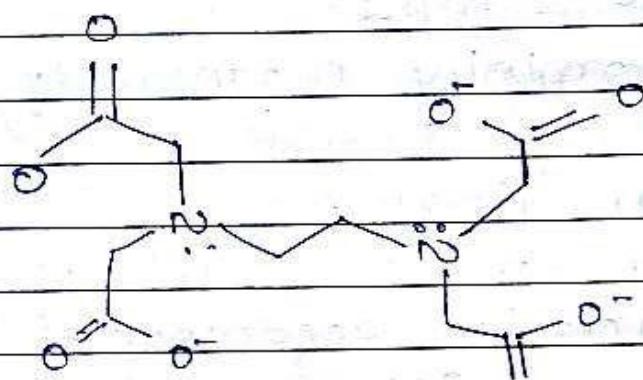
In this titration, 1st, metal ions react with indicator and forms metal indicator unstable complex. Then EDTA is added which react with metal ion to form metal EDTA stable complex. So, later metal indicator complex breaks and give free metal ion to react with EDTA. At equivalent point, free metal ions are not present and thus, free indicator ions gives a colour which is different from colour of metal indicator complex.

Metal ions cannot be titrated with simple & tibane ligands such as NH_3 , CN , because of lack of sharp

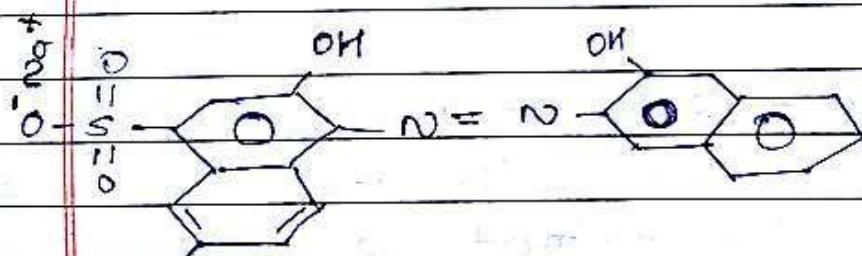
It involves reaction of metal ions & complexing agent (Ti^{+2}) to give stable complex.

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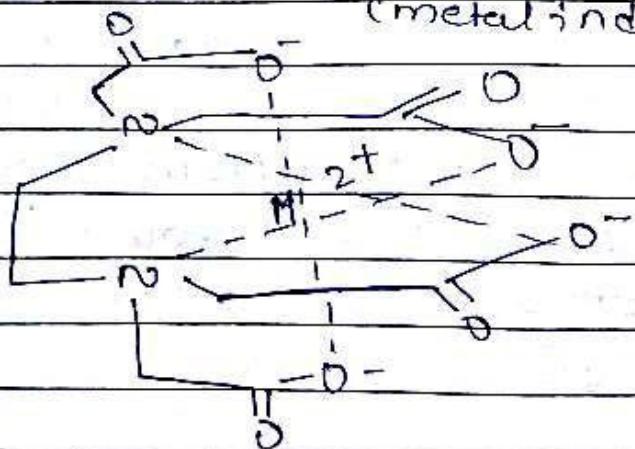
end point. This titration is only possible if the complex formation occurs in one step with high stability constant.



EDTA.



EBT Winereed - Blue (free form)
(metal indicator complex)



④ Application of Complexometric Titration

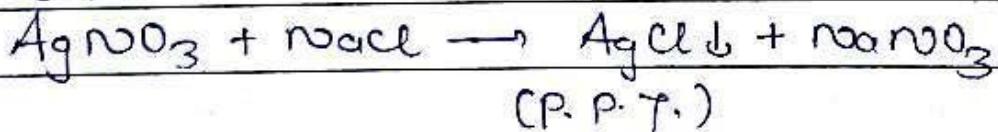
- For determining various matters like Ca, Mg, Zn, Pb, Fe, Mn, etc present in the water sample.
- For determining hardness of water.

⑤ Precipitation Titration:-

(Argentometric Titration) :-

The titration accompanied by formation of sparingly soluble salts when the solution of two reacting substances are into contact with each other are called P.P.T. Titration.

For Ex:-



V.V.T

Some important points :-

- ① These rxn. are limited to those involving solutions and hence are called Argentometric titration.
- ② In this types of titrations, solubility product play a key role. The option occurs only when actual ionic product exceeds the solubility product.

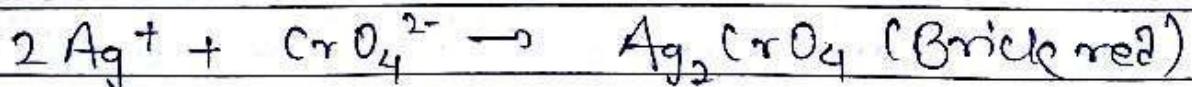
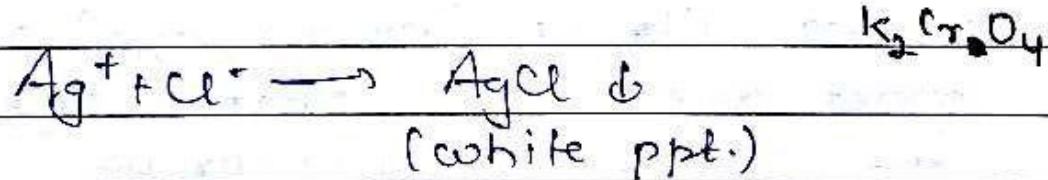
③ The precipitation must be practically insoluble; formation of ppt. must be rapid; and equivalence point should be easily detectable.

④ Indicator in Ppt. titration:-

There are 2 types of argentometric titration depending upon indicator use :-

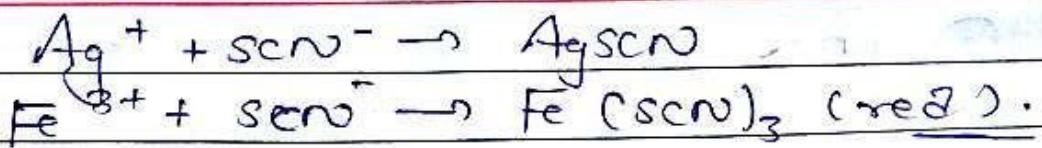
→ Mohr's Method:-

Natural halides are titrated with silver nitrate using potassium chromate as indicator & this method is called Mohr's Method & is developed by Mohr scientist. At the end point of titration, brick red ppt. forms



⑤ → Volhard's Method:-

It was developed for the estimation of Ag in dil. HNO_3 solution by titrating against a standard thiocyanide solution in presence of ferric salt as indicator.

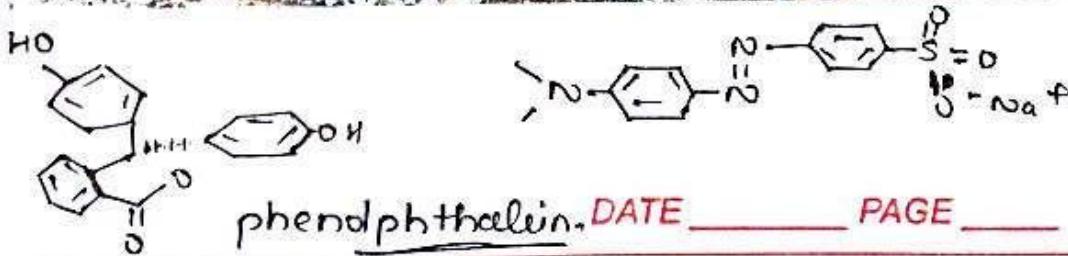


Q) Applications of precipitation titration:

- Used for the determination of halides & pseudo halide.
- To determine solubility constant of the compounds.
- To determine electrode potentials.
- For determining chlorides, sulphides, cyanides, thiocyanates.

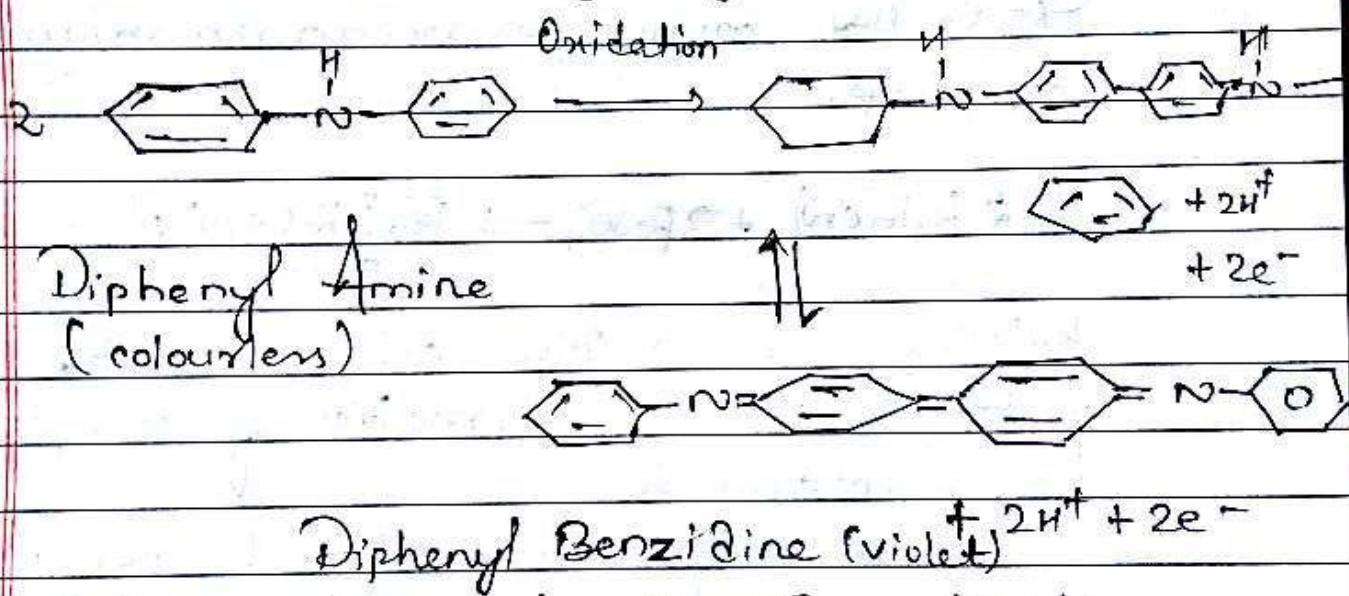
Indicators:

It is a large organic molecule that works like a "colour, dye". Whereas, most dyes do not change colour with the amount of acid or base present. There are many few molecules known as Acid-Base indicators which respond to change in colour with respect to hydrogen ion concentration.



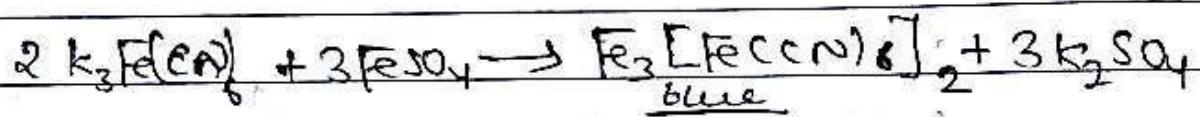
Types:-

- ✓ 1. Internal Indicator:- If the indicator is added to the liquid which is being titrated, it is called as Internal Indicator.
- Internal Indicators such as Titrus solution, phenolphthalein, Methylorange, etc.



It is an example of redox-titration. Diphenyl Amine is one of the internal indicator employed in redox titration. It is used for the titration of Fe^{2+} with $K_2Cr_2O_7$. The indicator has diff. colour in Oxidized & reduced form. When all the Fe^{2+} ions are oxidized to Fe^{3+} ions by $K_2Cr_2O_7$, then an extra drop of $K_2Cr_2O_7$ is added to the solution will oxidize the indicator Diphenylamine which changes to blue violet colour & hence make completion of rxn.

ii. External Indicator + Those indicator which cannot be added into the volumetric flask in which titration is carried out but are used externally are called External Indicators. Potassium ferricyanide ($K_3Fe(CN)_6$) is generally used as E.I. In the titration of $K_2Cr_2O_7$ with ferrous ammonium sulphate.



$K_3Fe(CN)_6$ gives a blue colour with Fe^{2+} -ions with due to the formation of complex Ferriferricyanide.

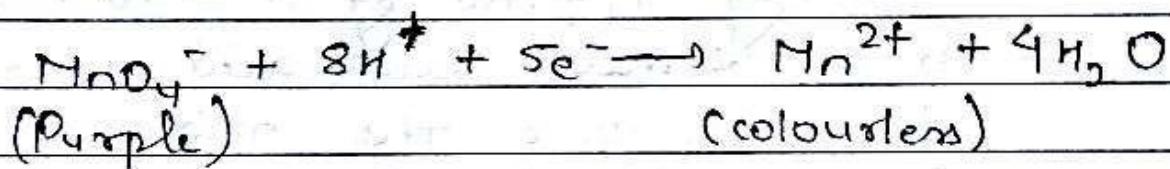
The drop of external indicator are placed on a white tiles by means of dropper during the titration, the drop of titration mixture are taken out and are tested by mixing the indicator solution in the tiles.

Appearance of blue colour shows that the end point is not reached a ~~apparatus~~ titration continues till the non. mixture gives no colour.

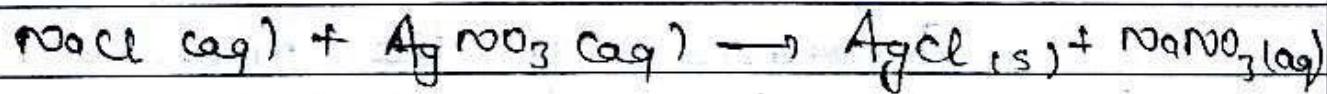
3. Self Indicator : If the reagent or the reacting solution is strongly coloured & is de-coloured by the substance that is being determined, then it is called self indicator.

For Ex.

KMnO₄ is purple in its oxidized form but its reduced product i.e. Mn²⁺ ions



L7. Adsorption Indicator & A type of indicator used in. rxn. that involves pptn.



Theory of Indicators :-

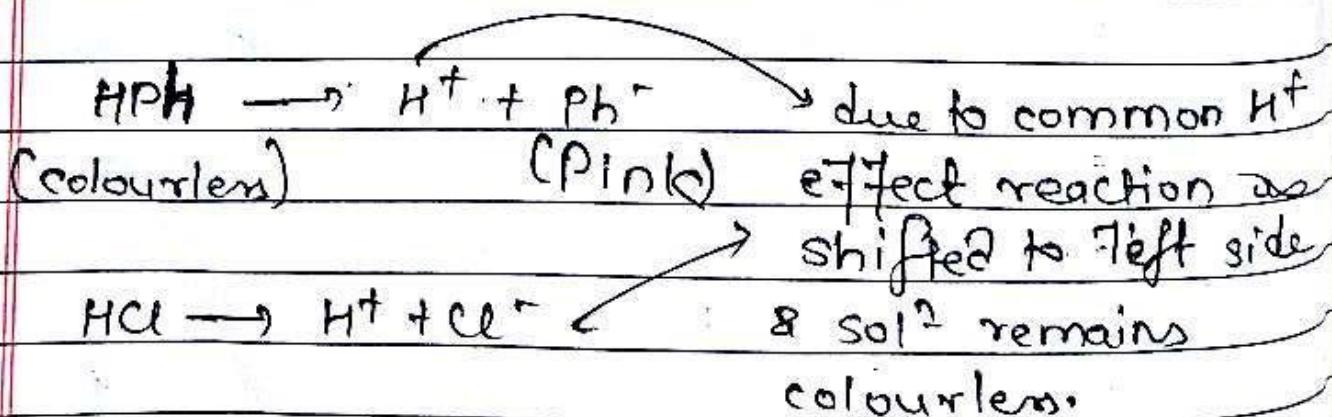
a. Ostwald's Theory :-

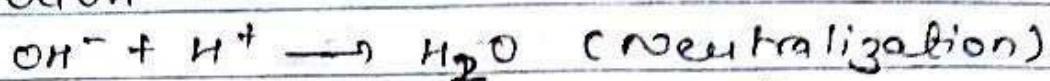
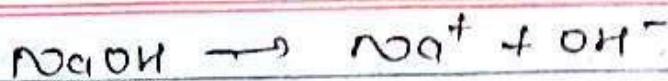
According to this theory,

i. the colour change is due to the ionisation of the acid base indicator. The un-ionised form has different colour than ionised form.

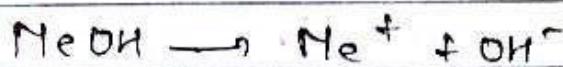
ii. the ionisation of indicator is largely affected by in acid & base as it is either weak acid or weak base. In case the indicator is a weak acid, its ionisation is very much low in acid due to formation of common H^+ ions, while it is nearly ionised in alkalies.

Similarly, if the indicator is weak base, its ionisation is large in acid & low in alkalies due to common OH^- ions.



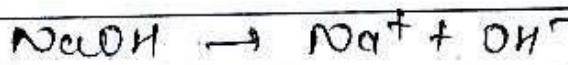
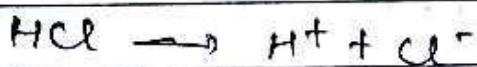


& solution becomes pink.



Yellow (red)

due to common OH^-
effect, min. Me^+ shifted
to left side & sol²⁻
remains colourless.



& sol²⁻ becomes pink.

(*) Quinonoid theory:

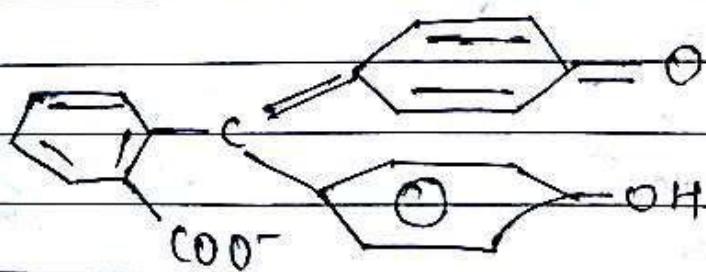
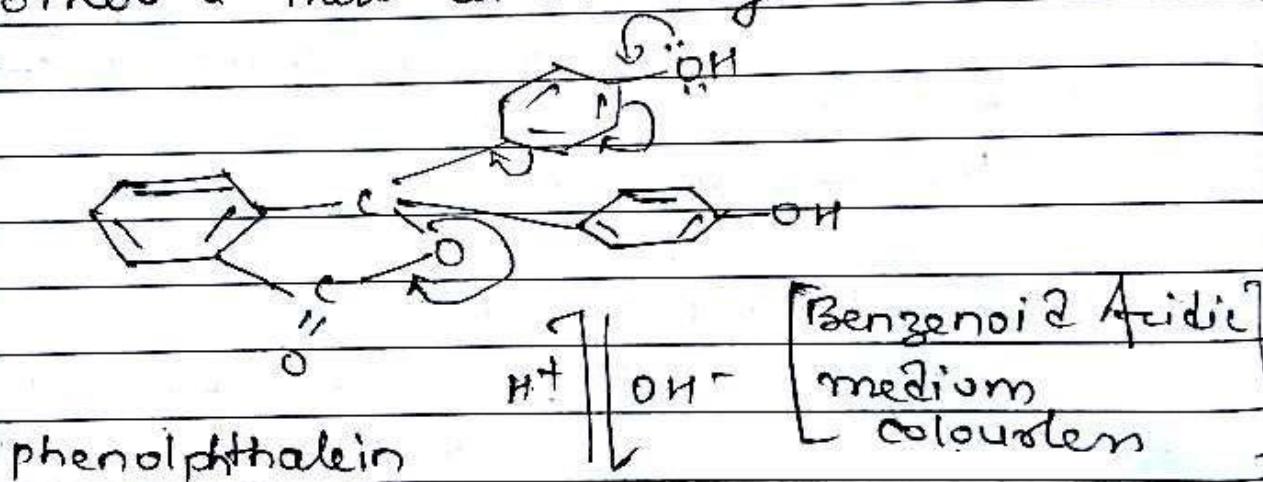
According to this theory:

- ① The acid-base indicator exists in 2 tautomeric forms having different structures. Two forms are in equilibrium. One form is benzenoid & other is quinonoid form.

- ② The 2 forms have different colours. The colour change is due to the

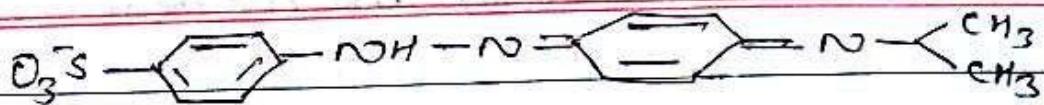
interconversion of one tautomeric form into other.

(iii) One form mainly exists in acid medium & other in alkaline medium. Thus, during titration, the medium changes from acid to alkaline or vice-versa. The change of pH converts one tautomeric form into other & thus colour change occurs.

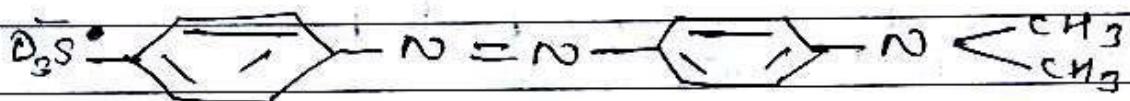
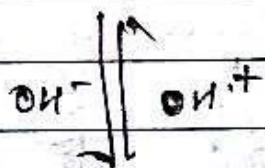


Quinonoid's form
(Basic medium)
Pink colour

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Quinonoid form - Acidic solution.
red colour.



Benzoid form (Basic form)
(light orange).

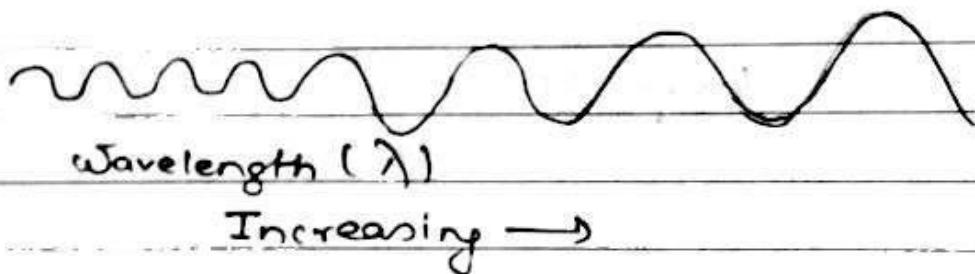
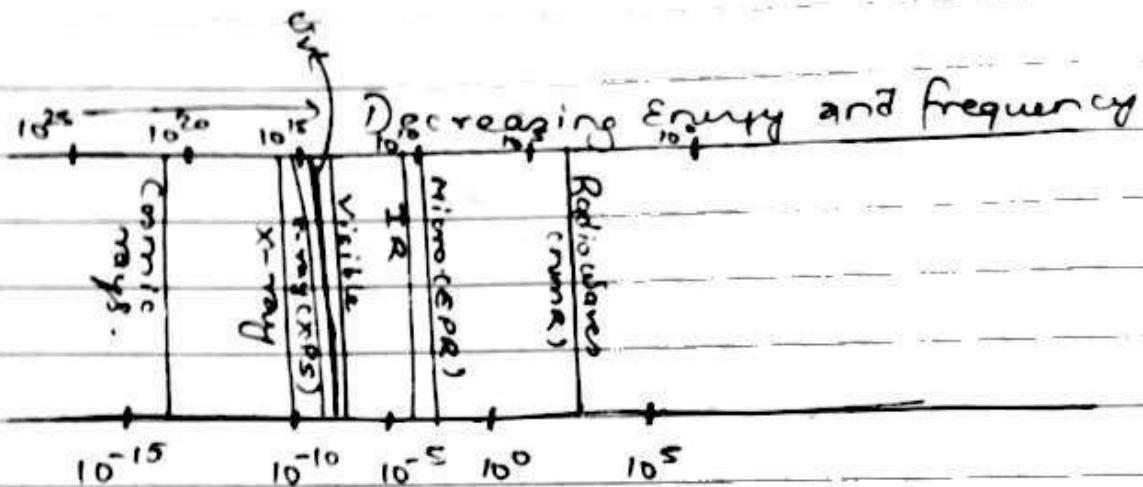
Unit
2.

Spectroscopy + Branch that deals with the interaction between electromagnetic radiation and matter.

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Spectral Methods of Analysis :-

1. UV
- II. FT-IR
- III. NMR
- IV. Mass Spectroscopy



④ UV-Spectroscopy:- Electronic Spectroscopy

It deals with the recording of absorption of radiations in the UV and visible regions of the E-M spectra.

UV \rightarrow $10 - 400 \text{ nm}$

Visible \rightarrow $400 - 800 \text{ nm}$.

It is subdivided into near UV (quartz region) ($200 - 400 \text{ nm}$) & far UV region ($10 - 200 \text{ nm}$).

$\frac{I_0}{I}$ imp. num. Absorption law or Lambert's and Beer's law:-
And Molar Absorptivity

According to Lambert's law, the fraction of incident monochromatic radiation absorbed by homogeneous medium is independent of the intensity of incident radiation, while Beer's law states that, Absorption of monochromatic radiation by a homogeneous medium is proportional to the number of absorbing molecule.

$$\therefore \text{Transmittance } (T) = \frac{I}{I_0} \quad (\text{Incident radiation})$$

The transmittance can be expressed by absorbance, $A = -\log \left(\frac{I_0}{I} \right)$

Lambert's law:-

$$-\frac{dI}{dx} \propto I$$

$$A = \epsilon L$$

↳ absorption coefficient.

Beer's law:-

$$\therefore -\frac{dI}{dx} \propto CI \quad \therefore A = \epsilon CL \quad \begin{matrix} \downarrow \\ \text{length of tube} \end{matrix}$$

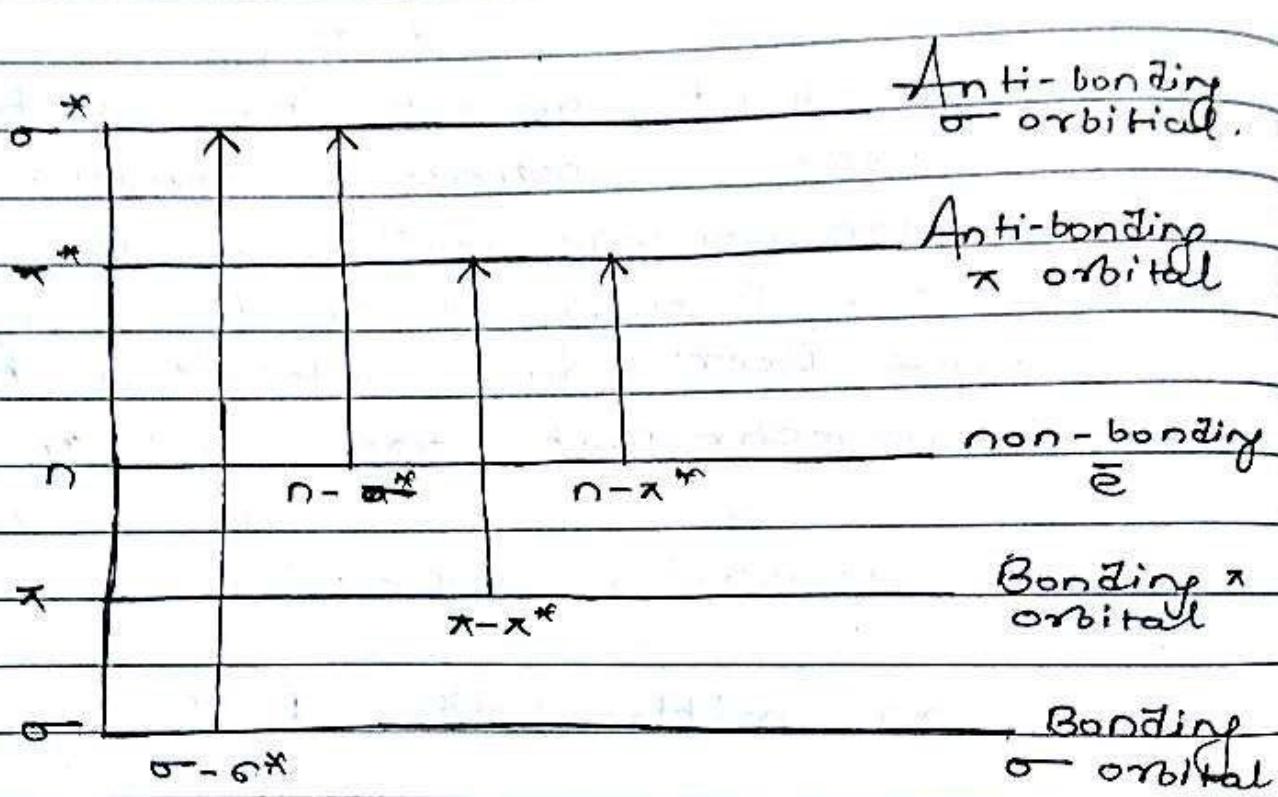
\downarrow

molar absorptivity.

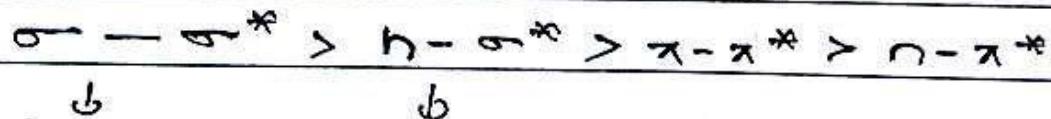
concentration

$$\log_{10} \frac{I_0}{I} = A = ECl$$

ν^{∞}
Imp.

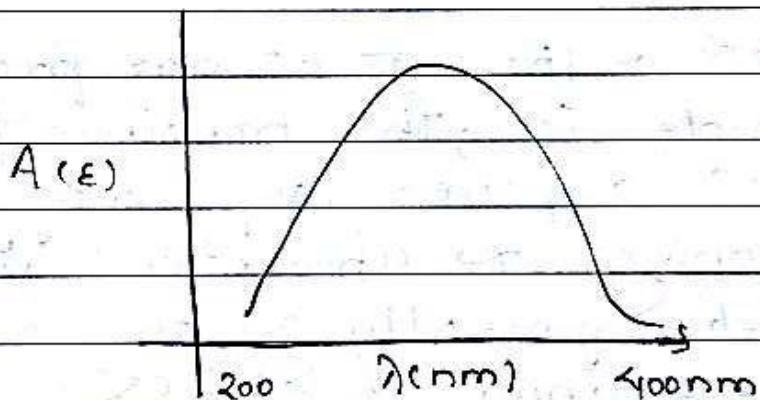
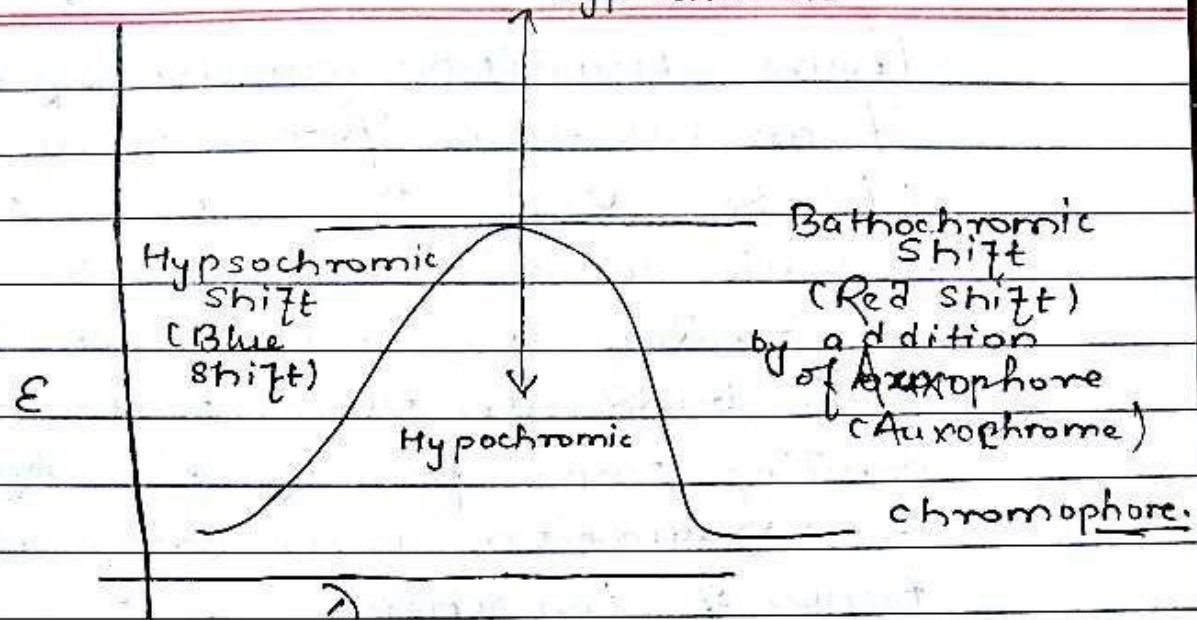


The order of energy required for electronic transitions:



below 200 nm (120-200 nm)	(200-290 nm) (c-c)	(270-329) Saturated halides	(270-350 nm) Alcohol	[$c=c$] $c=c$	[$c=O$] $c=s$ $N=O$
			Ethers		

Hyperchromic



UV-spectroscopy is used to measure the number of conjugated double bonds and also aromatic conjugation within the various molecule.

Types of Electronic Transition

~~②~~ Absorption of UV-radiation by an organic molecule leads to electronic transition betⁿ various energy levels.

These transition consist of excitation of an electron from highest occupied MO to LUMO. Now, the electrons in organic molecules may be involve in bonding as strong sigma bond, weak π bond or present as a ~~weak~~ non-bonding lone pair of e^- . Absorption of UV-radiation can bring about 4 types of transition.

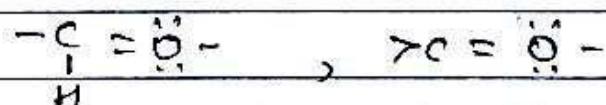
① $\sigma - \sigma^*$: The σ & e^- are present in the molecule ; the transition from σ to σ^* requires large energy corresponding to absorption in UV-region. It absorbs generally in the range of 120 nm - 200 nm. $> c \doteq c <$

Imp. ② $\pi - \pi^*$: The transition can take place in compound containing double or triple bond. The excitation of π -electrons requires smaller energy and hence transition occur at longer wavelength. In an conjugated alkenes ($> c = c < > c \equiv c <$),
absorption band occurs from 190 - 250 nm.

c. $n - \pi^{\star} \rightarrow$ In this transition, one of unshared e⁻ pair on a hetero atom is excited to π^* orbital (π -antibonding). As these non-bonding e⁻s are loosely bonded, so the transition requires longer wavelength. This transitions occur with compound containing double bonds having ($C=O$, $C=S$, $N=O$) involving hetero atom having unshared pair of e⁻.

for ex.

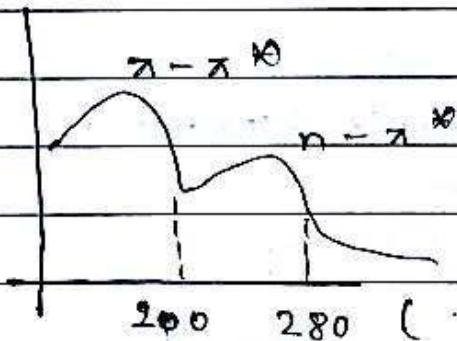
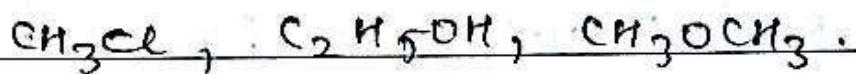
In aldehyde and ketone;



two bands at 180 - 200 nm ($\pi - \pi^*$)
280 nm ($n - \pi^*$)

✓ * $n \rightarrow \pi^*$ transition is less intense because the e⁻ in n-orbital are situated perpendicular to the plane of the π -bond and hence the probability of e⁻ from n to π^* is low.

16. ~~$\pi + \pi - \pi^*$~~ :- The excitation of an e^- in an unshared pair of an atom to an anti-bonding σ -orbital is called $n - \pi^*$ transition. Such transition requires less energy compared to $\sigma - \sigma^*$ transition. This type of transitions shows saturated halides, alcohols & ethers.



* Transition Probability:

Depending upon the value of excitation coefficient, the transition can be classified as

- ① Allowed Transition.

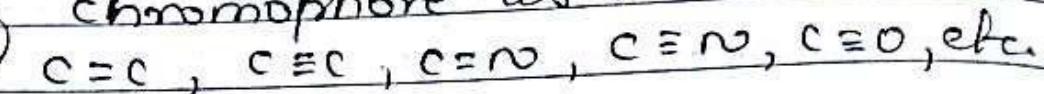
- ② Forbidden Transition.

① The transition with value of E_{max} more than 10^4 , transition is allowed. It is generally due to $\pi - \pi^*$ transition. The transition with the value of E_{max} below 10^4 are forbidden transition & are due to $n - \pi^*$ transition.

Chromophore: is an any system or any functional group which is responsible for imparting colour to the compounds. For ex. In nitro compounds, the yellow colour is carried by the NO_2 group & hence NO_2 group is a chromophore. But in these days, chromophore is defined as the covalently bonded unsaturated groups that shows a characteristic absorption in UV or visible region. The absorption occurs

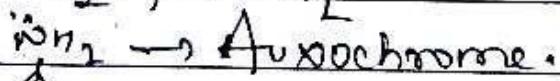
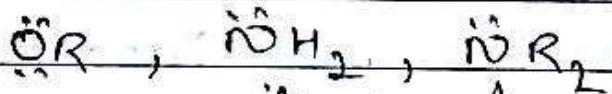
irrespective of the fact where the colour is produced or not. Typical

Ex. of chromophore is :-



to increase

Auxochromes & it can be defined as any group whose presence brings about the shift of absorption band towards the longer λ region or vice-versa. Actually, it is the colour enhancing group. The effect of auxochromes is due to its ability to extend the conjugation of chromophore by the sharing of non-bonding e^- . Thus, a new chromophore results which has different value of absorption maxima. Examples of Auxochromes :-



$$\lambda_{max} \rightarrow 255 \text{ nm}, \lambda_{max} \rightarrow 280 \text{ nm}$$

$$E_{max} \rightarrow 203$$

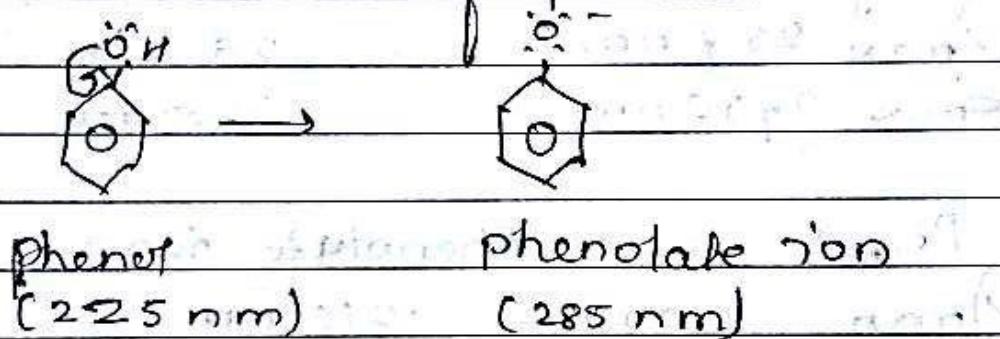
$$E_{max} \rightarrow 1430$$

If a group of atom which will impart a particular colour when attached to a chromophore but present alone, will fail to produce colour.

① Bathochromic Shift (Red Shift)

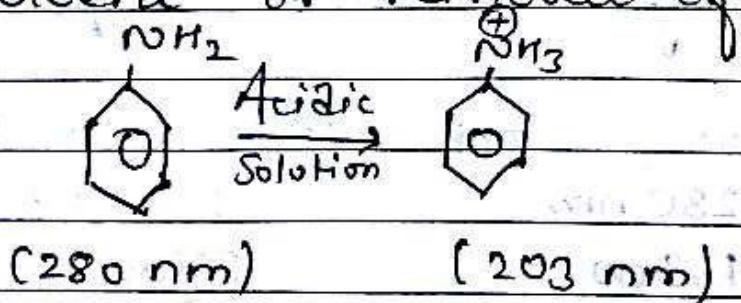
Shift of absorption maxima to longer λ is called bathochromic shift. It may be due to the presence of auxochrome or change in the polarity of the solvent.

Conversion of phenols



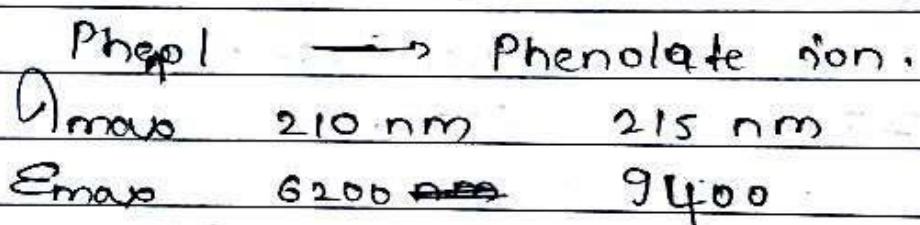
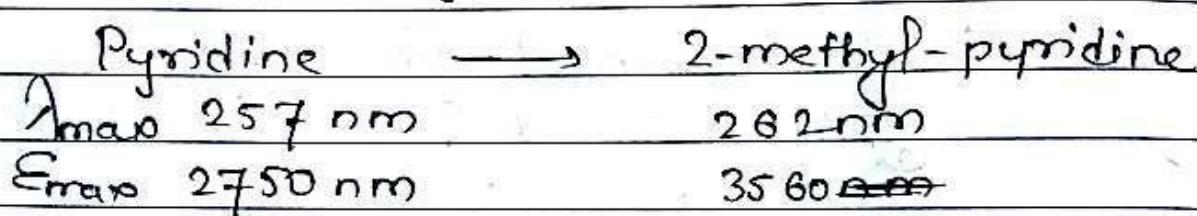
② Hypochromic shift (Blue shift)

Shift of absorption maxima to shorten λ region is called Hypsochromic shift or blue shift. It may be due to the increase in the polarity of the solvent or removal of conjugation.

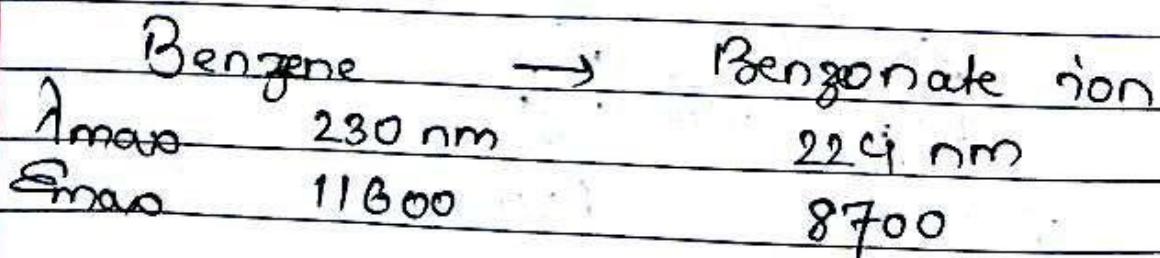


~~Imp.~~

~~Hypsochromic shift :- It is the effect leading to increase in intensity of absorption maxima (ϵ_{max} increases). The introduction of ^{aromatic} chromone usually decreases the intensity of absorption maxima.~~



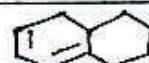
~~Hypochromic shift :- It is the effect leading to decrease in intensity of absorption maxima. The group which distorts the geometry of molecule cause hypo-chromic shift.~~



(*) Woodward's Fries Rule :-

Conjugated dienes :-

i) Homoannular dienes :-



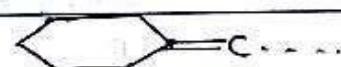
ii) Heteroannular dienes :-



iii) Endocyclic Double bond :-



iv) Exocyclic Double bond :-



For calculation λ_{max} :-

* Base value for λ_{max} (nm)

molecules

Alicyclic dienes → 217

Cyclic conjugated dienes → 217

Homoannular c.d. → 253

Hetero 4 4 → 215

Alicyclic Tri-ene → 245

* Increment for

Each Substituents

Alkyl (-CH₃) 5

Ring Residue 5

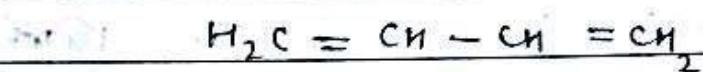
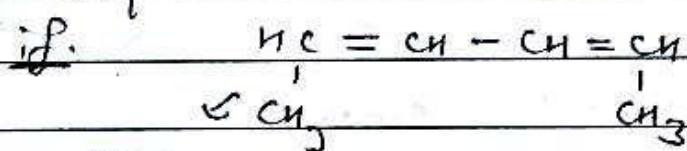
Exocyclic Double bonds 5

Double bond extending Conjugation 30

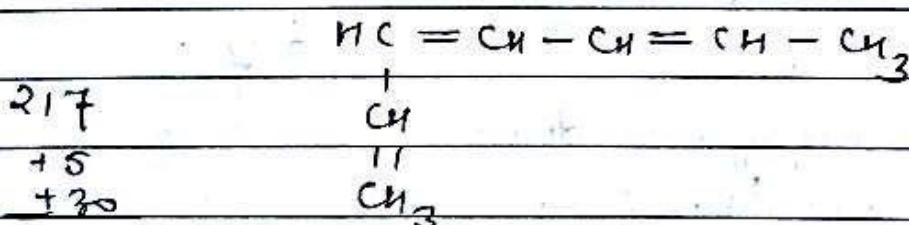
x. Onychromes

- OR	6
- SR	30
- Cl, - Br, -	5
- NR ₂	60
- OAc	0

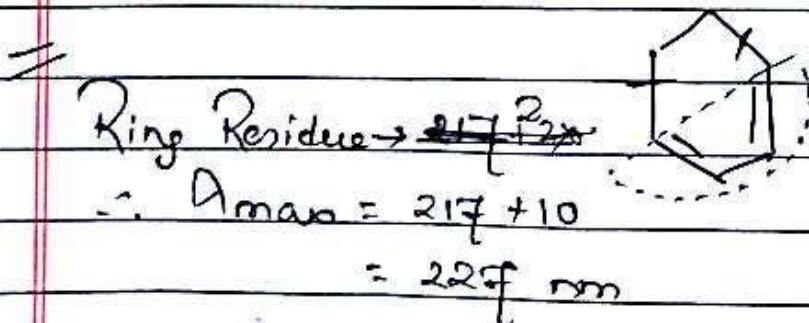
"

217⁶

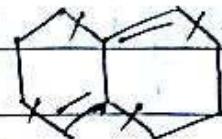
227.



252 nm

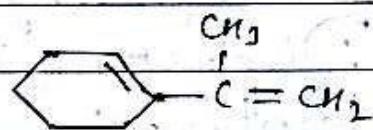


Ring Residue \rightarrow 504 \rightarrow 20
Heteroannular C.C. \rightarrow 215



2 Exocyclic Double Bonds \rightarrow 205 \rightarrow 10
 245 nm.

A-cyclic \rightarrow 217



Each Substituent \rightarrow 5

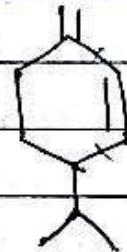
Ring Residue \rightarrow 205

232 nm.

A.C. \rightarrow 217

R.R. \rightarrow 10

Exocyclic 2.b \rightarrow 5



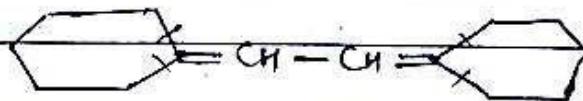
232 nm.

* A.C. \rightarrow 217

R.R. \rightarrow 20

D.B.S \rightarrow 10

247 nm.

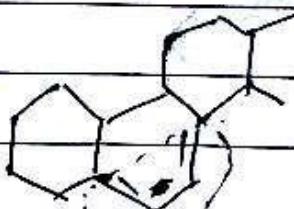


H.A. dienes \rightarrow 253

R.R. \rightarrow 20

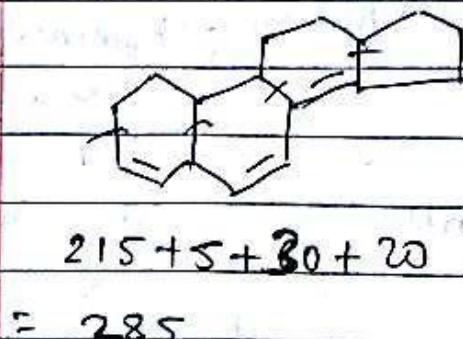
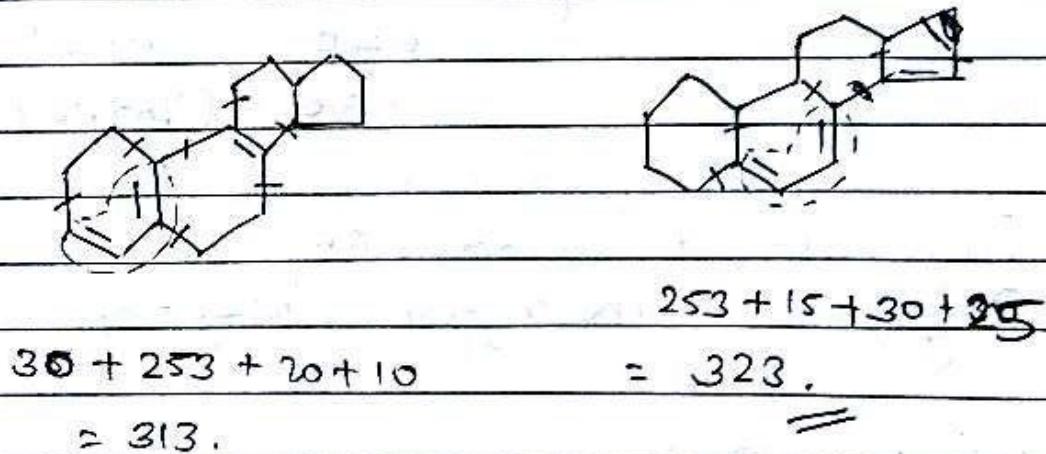
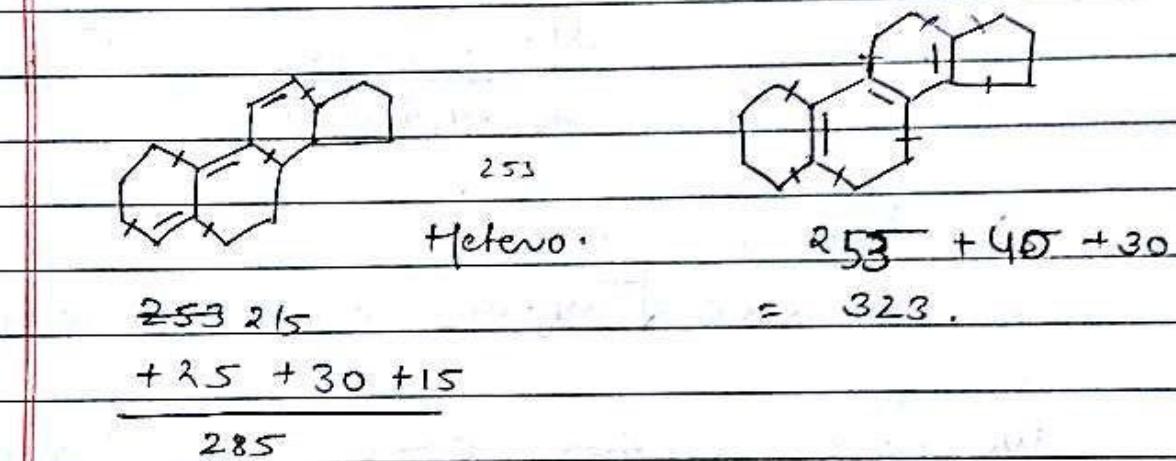
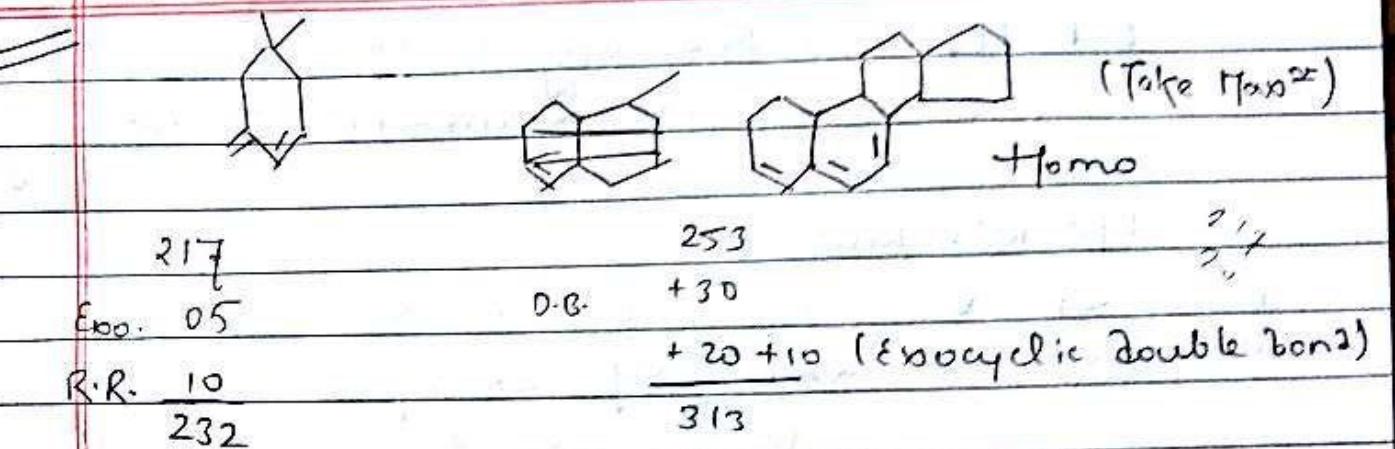
Substituents \rightarrow 10

283 nm.



Applications:

- i) Detection of functional groups or chromophore.
- ii) Extent of conjugation (addition in unsaturation shifts the absorption to longer wavelength)
- iii) Distinction in conjugation & non-conjug.
- iv) Identification of an unknown compound.
- v) Examination of polynuclear Hydrocarbons.
- vi) (The presence of substituents on the ring generally shifts the λ_{max} to higher value)
- vii) Determination of conjugation of geometrical isomers. (cyclohexene having lower λ_{max} than trans. isomers).



FT-IR Spectroscopy :- (667 - 4000 cm⁻¹)
 Fourier Transform - IR Spectroscopy.

Hooke's law :-

$$\text{Wave number} \rightarrow \nu = \frac{1}{2\pi c} \sqrt{\frac{k}{m}} \rightarrow \begin{array}{l} k \rightarrow \text{force constant} \\ m \rightarrow \text{dipole moment} \end{array}$$

$$\mu = \frac{m_1 \cdot m_2}{m_1 + m_2}$$

$$\therefore \nu = \frac{1}{2\pi c} \sqrt{\frac{k(m_1 + m_2)}{m_1 \cdot m_2}} \quad (\text{reduced mass})$$

We have : k for $c=c$ (5×10^5 dynes/cm)

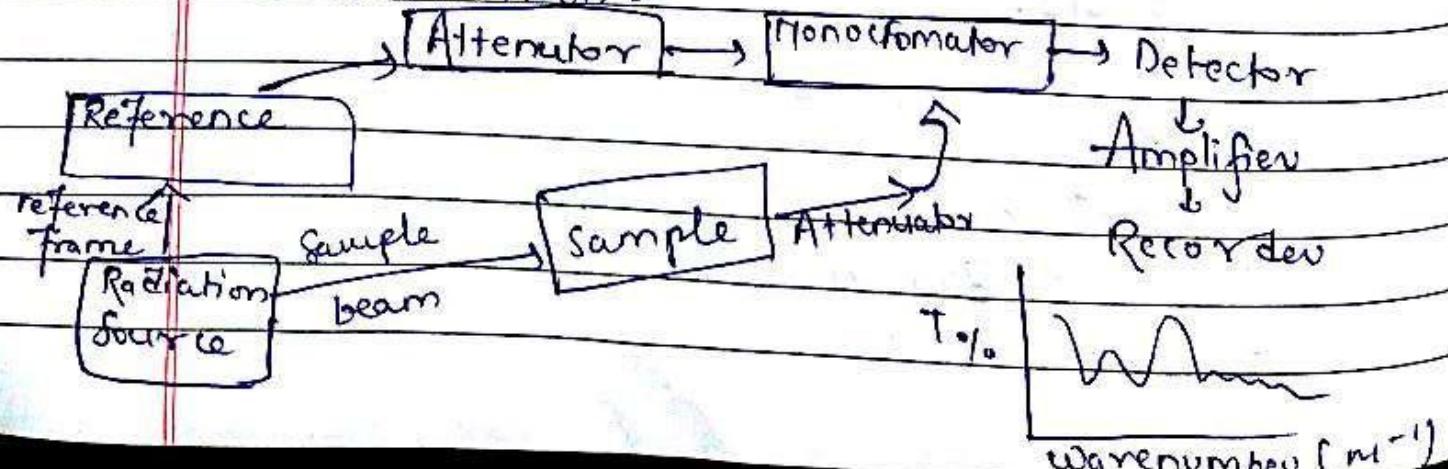
$c=c$ (Twice)

$c=c$ (Three times)

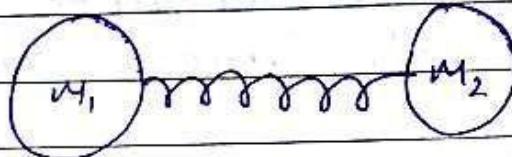
Finger Print Region : 667 - 1300 cm⁻¹

Ordinary IR region : 1300 - 4000 cm⁻¹.

Instrumentation :-



Original FTIR Spectrum:

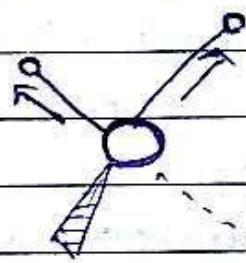


(Diatomic molecule)

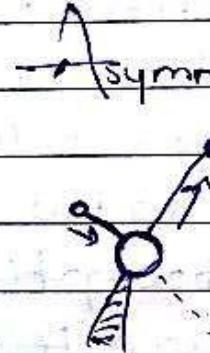
must have Dipole moment or
change in Polarity

1. Stretching Vibrations

Symmetrical

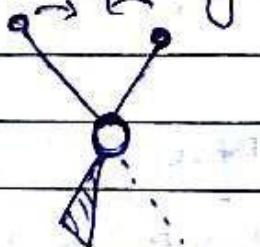


Asymmetrical

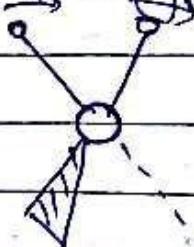


2. Bonding Vibrations

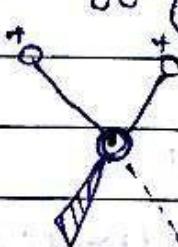
Scissoring



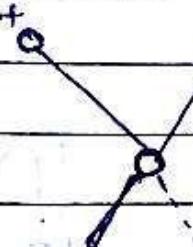
Rocking



Cheaging



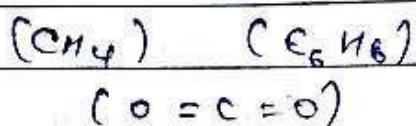
Twisting



Fundamental Vibration

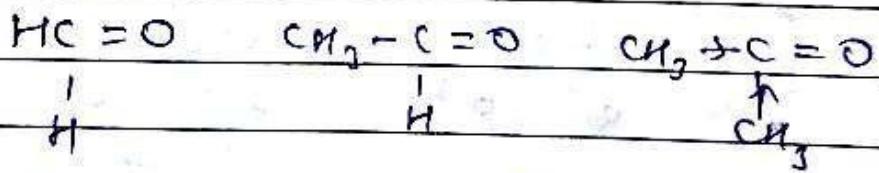
(3n - 6) for non-linear molecular

(3n - 5) for linear molecular



V.V.F. factors influencing vibrational frequency:

- ① Higher is the multiplicity of bond, higher is bond strength & higher is the value of force constant k . Thus, greater will be the frequency of absorption in IR region.
- ② Greater is the reduced mass, lower is vibrational frequency.
- ③ Electromeric Effect

 1750 cm^{-1} 1730 cm^{-1} 1710 cm^{-1}

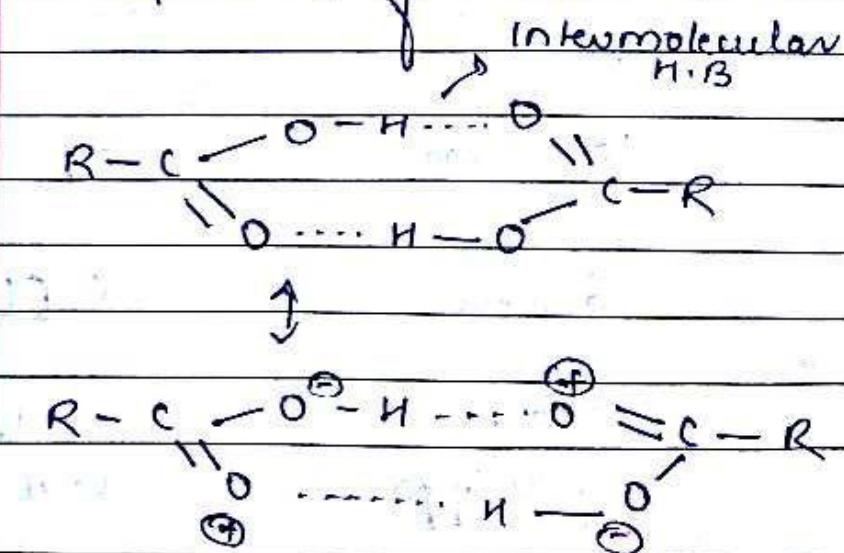
The introduction of CH_3 -group cause +I-effect in CH_3CHO & CH_3COCH_3 , which result in lengthening of bond & hence force constant is lowered and

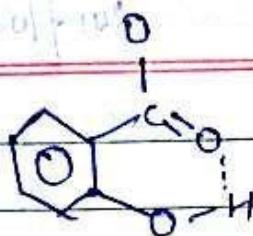
DATE 2017/03/08 GE

wave number is decreased.

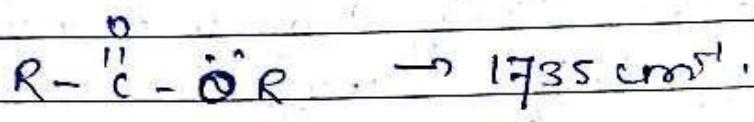
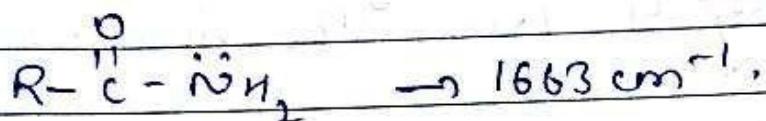
1. Hydrogen Bonding + (Why H lowers the vibrational frequency?)

H-bonding brings about downward frequency shift. Strong the H-bonding, greater is the absorption shift towards lower wave number than normal value. Moreover, inter and intramolecular H-bonding can be easily distinguished by IR spectroscopy. Generally, intermolecular H-bonding give rise to a broad bent. While intermolecular H-bonding gives sharp and well defined bent. Intermolecular H-bonding are concentration dependent and intensity of such waves decrease & finally disappear in dilution whereas intramolecular H-bonds are independent of concentration.





→ Intramolecular



~~Appr~~

(*) Characteristic IR absorption ~~frequencies~~

Groups Absorption freq. (cm^{-1}) Assignment.

CH_3 2840-3000 C-H stretch,

>C-C< 800-1200 C-C stretch,

>C=C< , 1620-1680 C=C " "

$-\text{C}\equiv\text{C}-$ 2100-2260 C≡C " "

>C-F 1000-1400 C-F

C- Cl 600-800 C-Cl

C-Por 500-750 C-Por

Benzene 730-770 C-H

OH

3590-3650

Free OH group.

O-H

3200-3500

Intermolecular H-B O-H gr

C=O

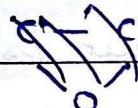
1000-1260

C=O

C-O-C

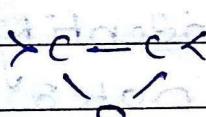
1060-1150

C-O-C



1240-1260

C=C



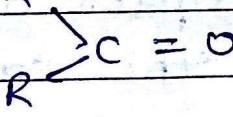
1720-1740

C=O



1705-1725

C=O



1700-1715

C=O



1735-1750

C=O

OR

RCO-NH_2	1690	$\text{C}=\text{O}$
RNO_2	1550-1570	$\text{N}=\text{O}$
$\text{R-C}\equiv\text{N}$	2200-2260	$\text{C}\equiv\text{N}$

* Application of IR Spectroscopy:

V.V.I.

i. Comparison of 2 compounds.

The IR spectroscopy is an important tool to establish the identity of a compound. It must be noted that 2 samples when run in same medium under similar condition will give the different spectrum unless the samples are same.

In that case, when samples are same, they will yield the same spectrum. i.e. so, IR spectrum is also called Finger Print of molecule.

In IR spectrum, region from 4000 to 1300 cm^{-1} gives the identification of functional groups. This region shows absorption due to stretching modes, whereas region below 1300 cm^{-1} to 667 cm^{-1} contains no. of vibration caused by bending and stretching.

vibration. All the organic compound have their unique absorption patterns in region of 1300 cm^{-1} to 667 cm^{-1} & hence, this part of spectrum is therefore known as finger-Print region.

2. Detection of Impurities in a Compound:

It is general fact that clean sample give sharp & clear Peak but if impurities are present, then IR spectra may consist broad and poorly resolved absorption bands.

3. Detection of functional Groups:

All the Functional Groups have their definite peaks.

4. Study of H-bonding.

5. Calculation of force Constant.

6. Determination of Orientation in Organic compounds.

7. Study of stereo-Chemistry of compounds.

3. Thermal Analysis. DATE 02/08 PAGE _____ (J&J)

a. TGA b. DSC c. DTA d. DSC