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Instrumental Methods of Analysis.

Qs. What are Electromagnetic Radiations?

Ans. The radiations which contains both the electric and the magnetic components, each mutually perpendicular to each other are called as Electromagnetic Radiations.

Examples :- Ultraviolet Radiation.

Microwaves

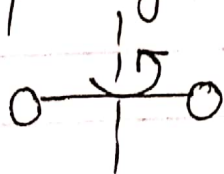
Infra red Radiations.

Qs. What are the different types of energy present in a molecule?

Ans. Different types of energy present in a molecule are :-

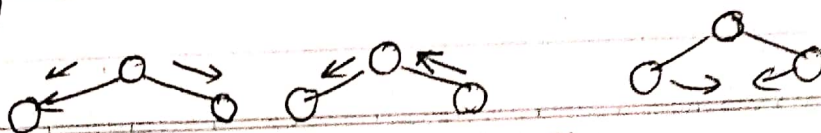
a) Rotational energy :-

This energy of a molecule is due to its rotation about the axes passing through centre of gravity.



b) Vibrational energy :-

This energy of a molecule is due to the vibrations of a molecule.



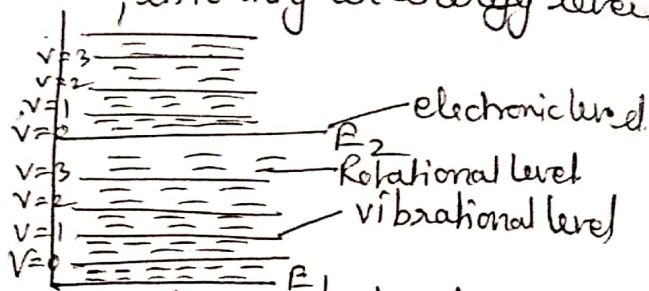
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Electronic energy:—

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It is due to excitation of electrons, into higher energy level by absorption of energy.



d) Translational energy:—

This energy is due to the movement of molecule along 3 axes.

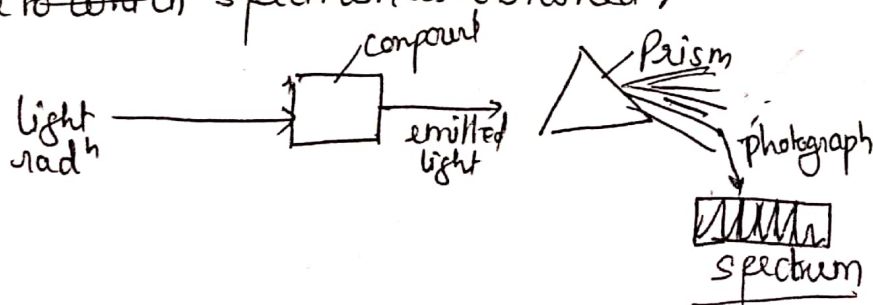
Qs. Define spectrum. & discuss its types?

OR

Qs Discuss. Absorption & emission spectrum?

Ans When the light radiations are irradiated (thrown) on an atoms molecule or organic compound, then some amount of radiations are been absorbed by the compound due to which either of the process like electron excitation, change in rotational or vibrational level of the molecule takes place. The light which is emitted out is passed through a prism.

(due to which spectrum is obtained) due to which various radiations are obtained the photograph of these radiation is called spectrum



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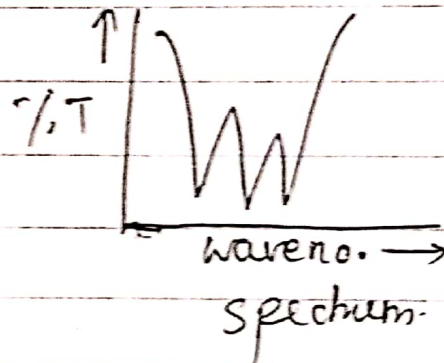
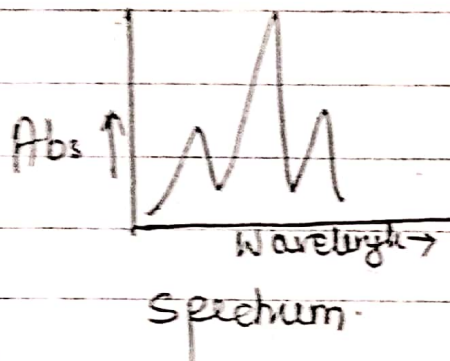
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Today, spectrophotometre device is used to obtain the spectrum of various substances.

Spectrum contains a plot of absorbance against wavelength.

OR.

Percent transmittance against (wavelength or) wave no.



Types of Spectra:— or Spectrum.

- 1) Emission spectra:— When a compound or molecule is irradiated with intense radiation then molecules absorb some radiations and get excited to the higher energy level, further the molecule returns back to its original level. In this process molecule emit out some radiations, and due to these emitted radiations the spectrum which is obtained is called emission spectrum.

Absorption spectrum:— When light is irradiated on the

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molecule or compound then molecule absorbs some of the radiations, and get excited to higher energy level; further the radiations are emitted out, spectrum which is obtained from these radi emitted radiation is called absorption spectrum.

Qs What the various types of electrons?

Ans Various types of electrons are:—

- a) ' σ '-electrons \rightarrow electrons which are involved in single bond formation i.e. σ bond ($C \equiv C$)
- b) ' π ' electrons \rightarrow electrons which are involved in double & triple bond formation: ($C \equiv C$) ($C \equiv C$)
- c) 'n' electrons \rightarrow electrons which are not involved in any bonding.

Qs. Write a note on U.V Visible spectroscopy or Electronic Spectroscopy.
OR

Qs. Give a brief Introduction of U.V visible spectroscopy? or Electronic Spectroscopy?
OR

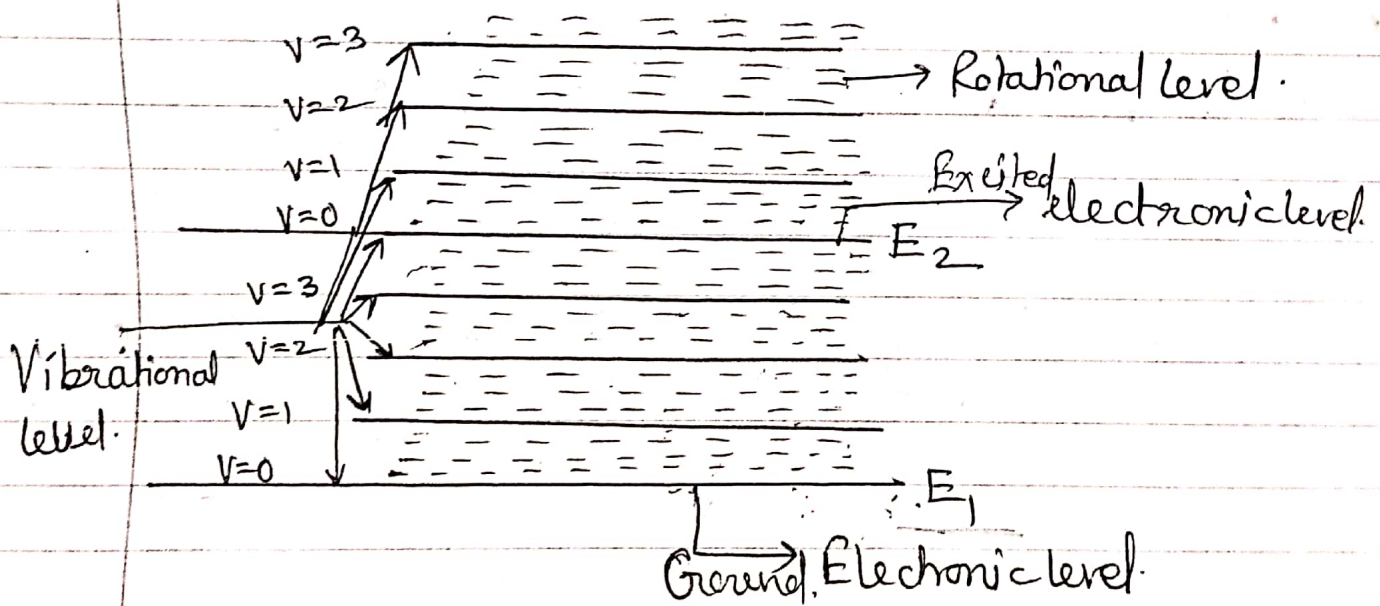
Qs Explain basic principle of U.V spectroscopy or Electronic spect.

Ans Introduction or Basic principle:—

Then the U.V radiations of wavelength ranging from

200 - 400 nm & visible radiations of wavelength range of 400 - 750 nm are absorbed by the compound or a molecule. then electronic transition or excitation takes place. With the electronic excitation simultaneous change of rotational & vibrational level also takes place.

Further from the emitted radiation we obtain ~~UV~~ spectrum called U-V spectrum. So we can say that U-V Spectrum is obtained due to the excitation of an atom or molecule from a particular combination of vibrational & rotational level in the electronic ground state to another different combination of vibrational & rotational level in excited state.

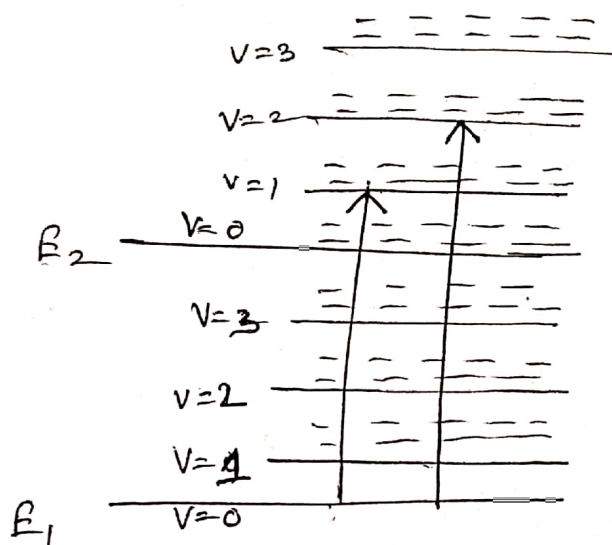


Thus U-V spectrum is an absorption spectrum obtained due to absorption of radiation.

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Excitation pattern



Various Electronic excitation takes place in a Molecule after the absorption of U-V/visible radiation, these are:-

According to Molecular orbital theory, due to the combination of atomic orbitals, molecular orbitals are formed; some molecular orbitals have high energy with respect to atomic orbitals. it is called as Antibonding molecular orbital, & those Molecular orbital which have Low energy in Comparison to atomic orbitals are called Bonding Molecular orbitals.

Thus in a molecule various orbitals are present are.

1) Bonding Molecular orbital
 σ, π

2) Antibonding Molecular orbital
 σ^*, π^*

Non Bonding Molecular orbital (n)

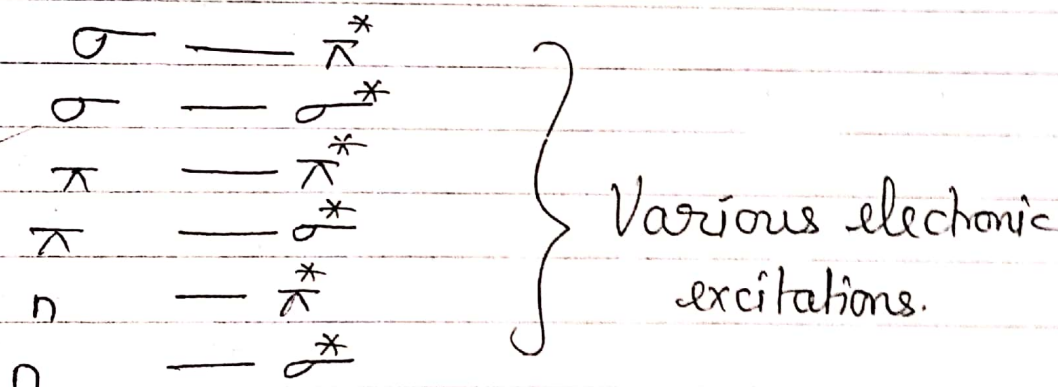
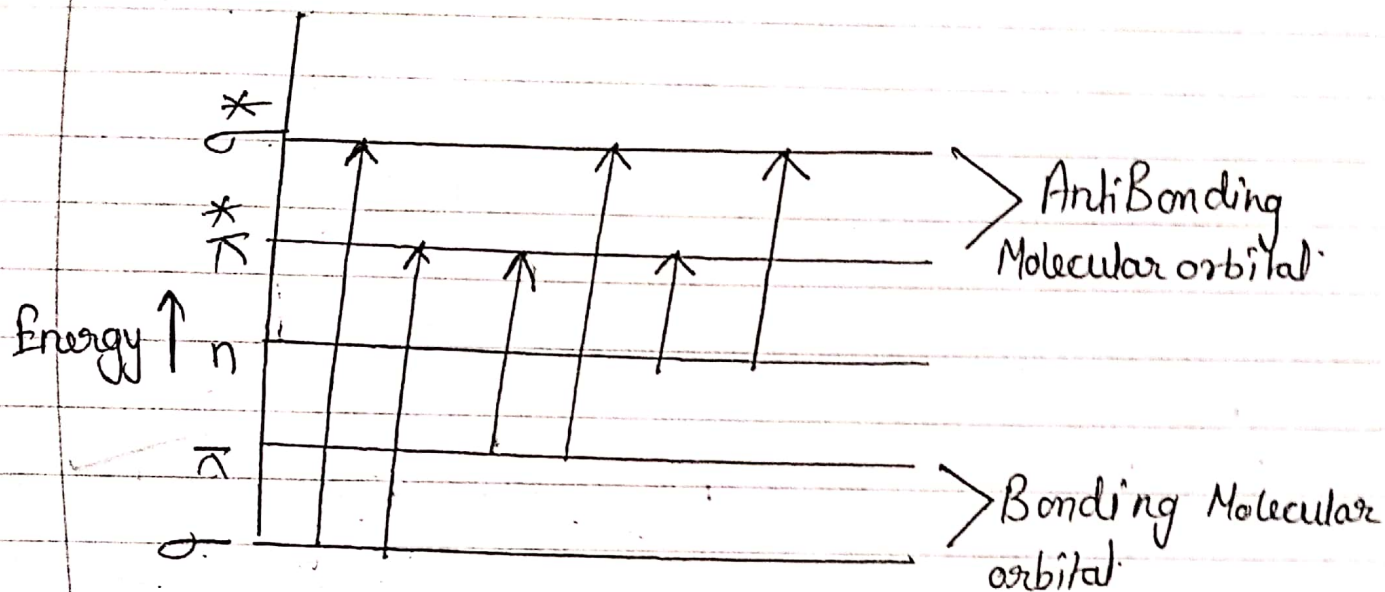
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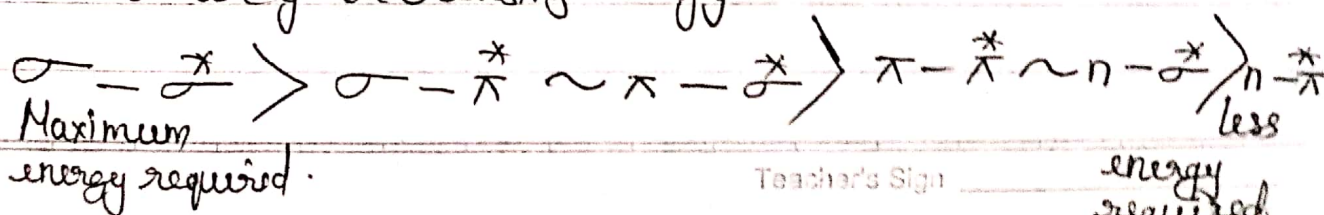
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So in a molecule, electron can be present in σ or π or n molecular orbitals. & the various electronic excitation which take place in a molecule after absorption of U.V/visible radiations are.



High energy is required for transition or excitation from $\sigma - \sigma^*$

So order of decreasing energy.



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the transition $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ & $n \rightarrow \pi^*$ require a (12) amount of energy for transition or excitation, so these are more possible transitions, which take place in a molecule having n or π electrons.

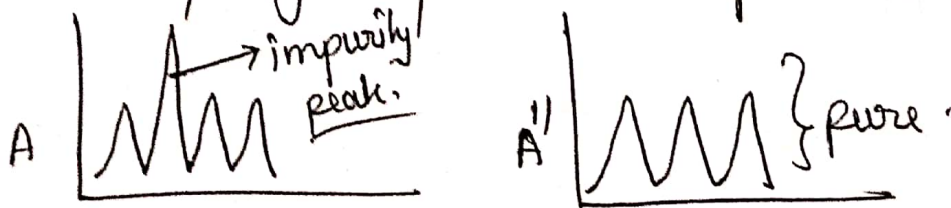
Qs Discuss the applications of U.V / Visible spectroscopy or

Qs Discuss the Applications of Electronic spectroscopy.

Ans Applications of U.V spectroscopy or Electronic spectroscopy are:—

A) Determination of impurity in a compound:—

for this, the U.V spectrum of a compound suppose 'A' (is taken out), in which impurity is to be detected is obtained with the help of U.V spectrophotometer. Then U.V spectrum of pure compound (A'') is obtained & further the spectrum of both the above compound is compared, if extra absorption band is seen in spectrum of 'A' compound then it means impurity is present in compound A.

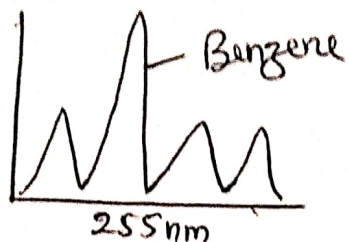


Example: —

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If Benzene is present in small quantity of cyclohexane. Then, it can be detected by U-V spectroscopy, as it gives an absorption band at 255nm.



impure cyclohexane



pure cyclohexane.

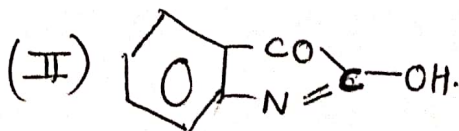
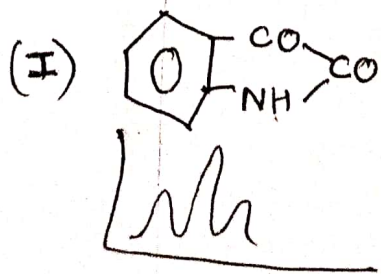
B) Determination of Ozone in Environment:—

Ozone concentration present in smoke fog (smog) in environment can be calculated by measuring its absorption band at 260nm.

C) Determination of structure of Organic compound:—

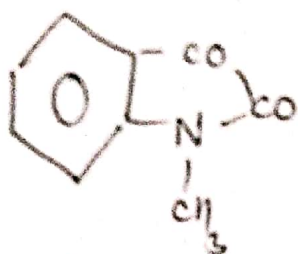
The compound which have similar structure give out same spectrum. (U-V spectrum)

Isatin → This compound was given 2 possible structures.

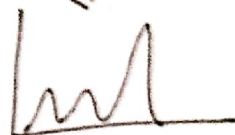
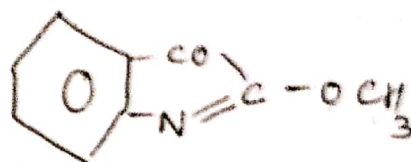


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In order to find out which structure should be assigned to isatin, Spectrum of other compounds like methyl ether was obtained. Methyl ethers have 2 known structures



N methyl ether



Further spectrum of above 2 methyl ethers were obtained & then the spectrum of isatin was compared with the spectrum of 2 methyl ethers, & it was seen that spectrum of isatin is similar to N-methyl ether; as the spectrum of N-methyl ether matched the spectrum of isatin. So isatin is assigned structure (I)

(D) Determination of Concentration of Compound in solution.

by using Lambert Beer's law equation $A = \epsilon c l$

Firstly, different concentration solution of a compound is made up, then by the help of U.V spectrophotometer, absorbance of each above solution is known then Graph is plotted between Absorbance & Concentration. At last absorbance

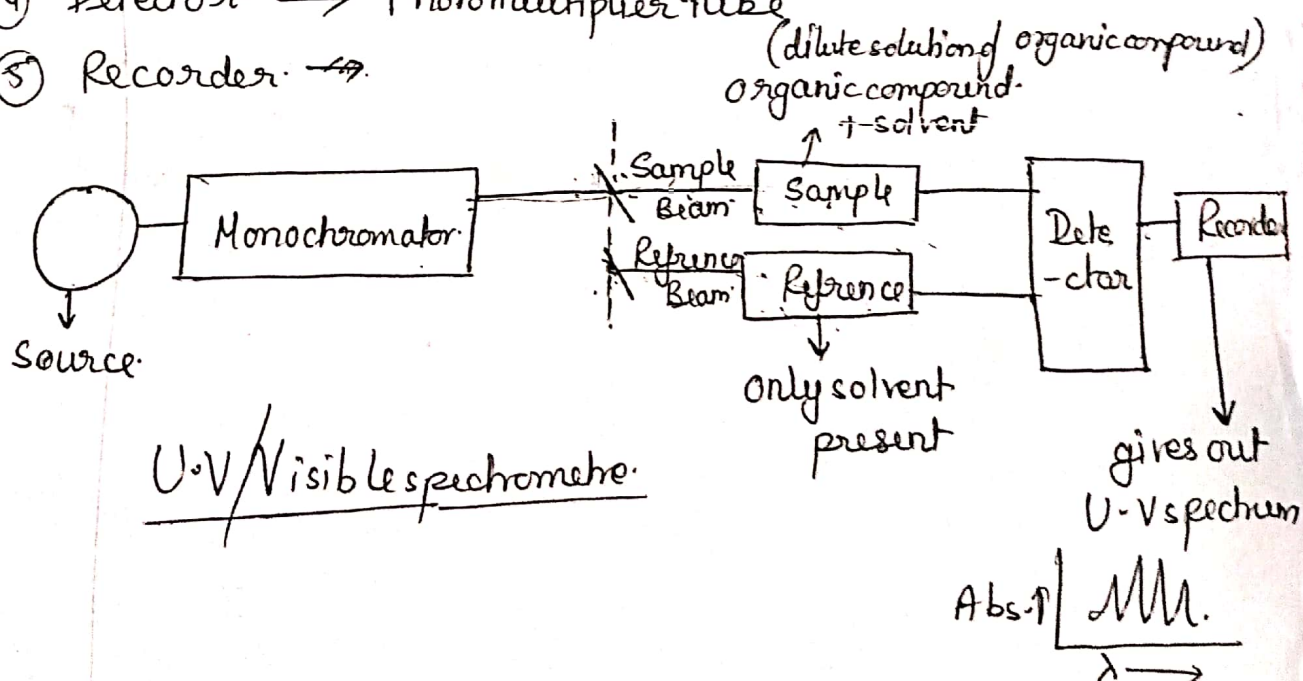
of Unknown concentration solution is found out by help of Spectrophotometer and concentration of Unknown solution is found by graph.

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Q. Discuss U.V spectrophotometer or spectrometry or U.V spectrophotometry
Ans. U.V spectrometry contains following parts

- ① U.V radiation source. \rightarrow Tungsten lamp for Visible radiation.
Deuterium discharge lamp for U.V radiation.
(Hydrogen)
- ② Monochromator \rightarrow It splits the radiation from the source into 2 parallel Beam-
or sample.
- ③ Transparent cell \rightarrow contains dilute solution of organic compound.
Reference cell. \rightarrow contains solvent.
- ④ Detector \rightarrow Photomultiplier tube
- ⑤ Recorder \rightarrow



U.V/Visible spectrophotometer.