UV VISIBLE SPECTROSCOPY

Spectroscopy:- The technique of determination of the concentration of substances in given solution with the help of light spectrum.

Spectrum Principles

- Absorption Spectrum → 1st unit
- Emmision Spectrum → 2nd unit

☆ When light enters or falls on the solution (given) or sample, then the molecules in ground state absorb light energy and get excited.

↓

Shows Absorption Spectrum

☆ After some time of excitation, molecules of sample can emit light energy and regain or come back to its groud state from Excited State

↓

Shows Emission Spectrum

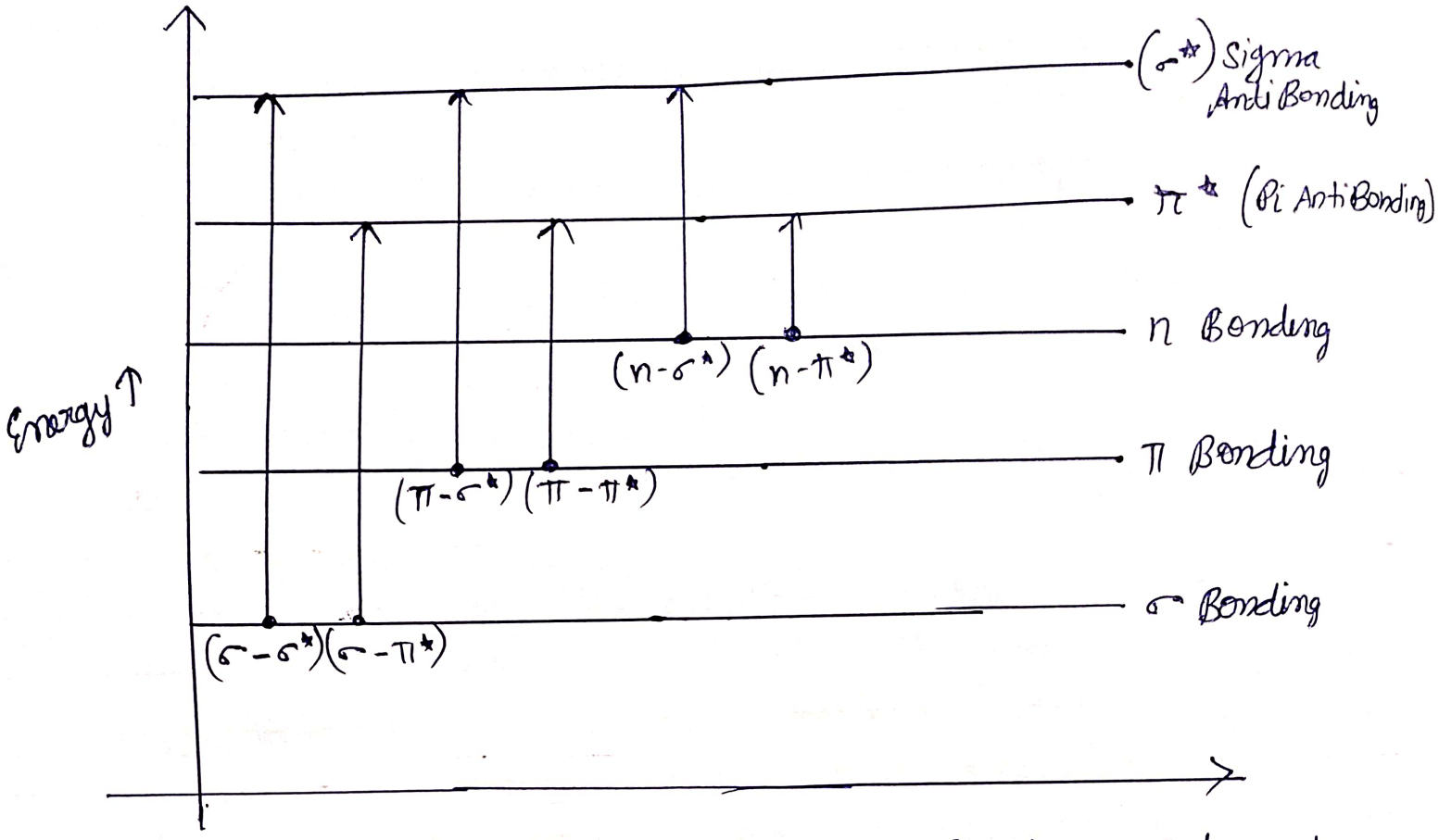
ELECTRONIC TRANSITIONS

The study of movement of molecules from ground to excited state after absorption of light is known as Electronic Transition.

⇒ different molecules absorbs light Energy and excite at different levels.

⇒ Various Types of molecules shows Transition.

* Sigma Bond (σ) → Compounds have Single Bond
  example - Methane, Ethane, propane etc.
* Pi Bond (π) → Compounds have Double Bonds
  example - Ethene, Propene etc.
* n - Bond → Compounds have Lone pair or free electron Pair.
  example - Ammonia (NH_3) etc.



In given Representation, different Bonded compounds Absorb energy and gain different Transition States.

① σ Bonding —gain Energy→ (σ-σ*), (σ-π*) } Transitions

② π Bonding —gain Energy→ (π-σ*), (π-π*) } Transitions

③ n Bonding —gain Energy→ (n-σ*), (n-π*) } Transition

* (σ-σ*) Absorbs More Energy
* (n-π*) Absorbs lowest Energy

Wavelength

- $(\sigma - \sigma^*)$ - About 125 nm
- $(\sigma - \pi^*)$ - About 150 nm
- $(\pi - \sigma^*)$ - About - 170 nm
- $(\pi - \pi^*)$ - About - 205 nm
- $(n - \sigma^*)$ - About - 250 nm
- $(n - \pi^*)$ - About - 300 nm

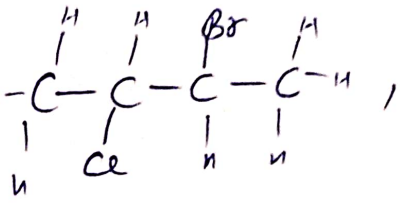
Chromophores

The Substances contain Functional group can responsible for the colour of a substance is known as chromophores.

Exam
- ✱ Multiple Bonded Compounds ($C=C$, $N\equiv C$) Absorbs About 200 NM of light.
- ✱ dienes (contain 2 double Bonds) ($C=C-C=C-C$) Absorbs about Less than 200 NM of light.

Auxochromes

The main group in Chromophores responsible for its colour is known as an Auxochrome

Exam - ✱ In compound  ,

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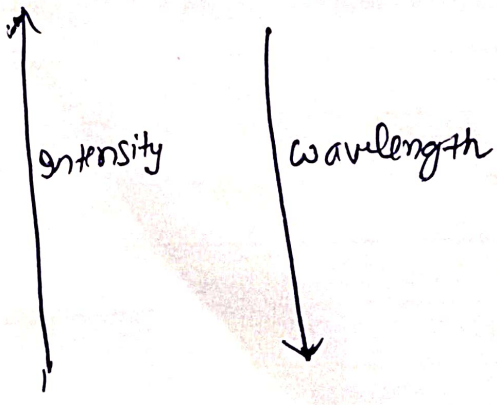
Bromine (Br) and Chlorine (Cl) are the auxochromes, whole compound is known as chromophore.

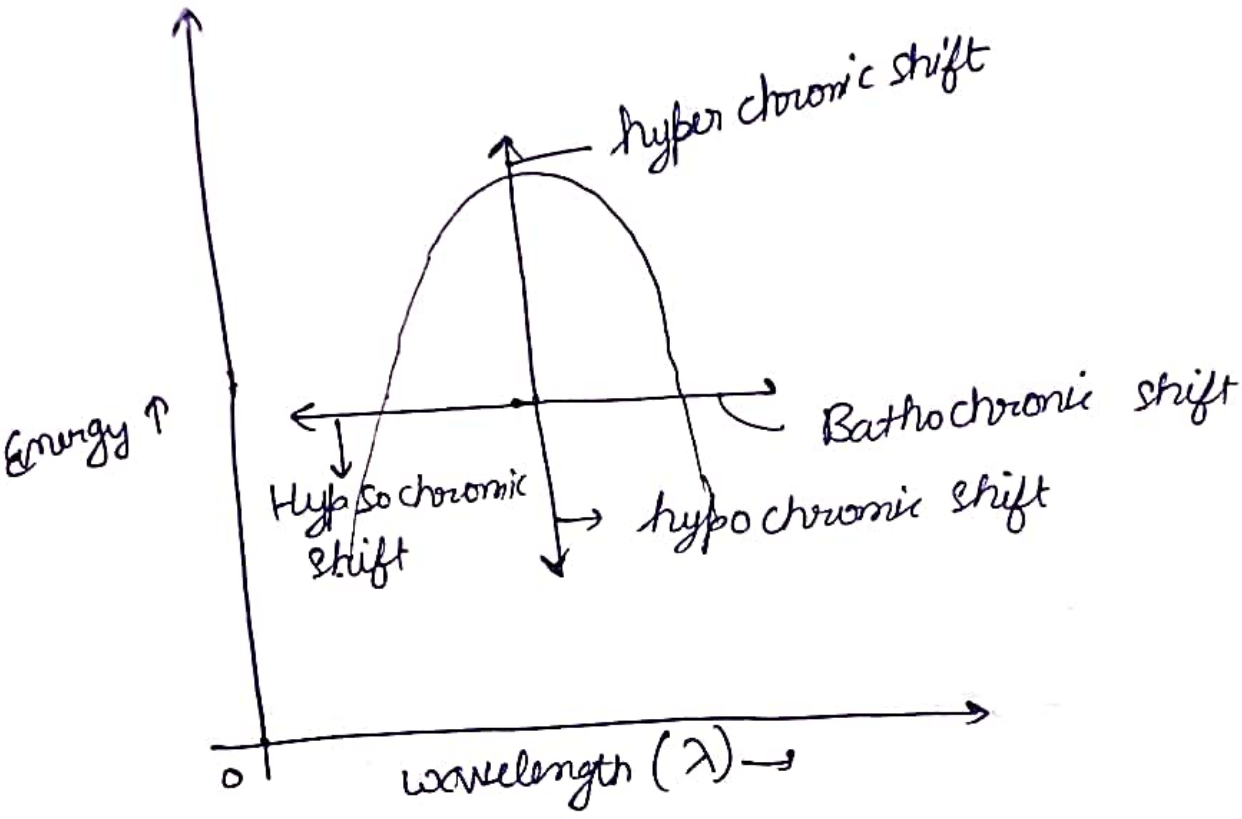
SPECTRAL SHIFTS

In different solutions, the Intensity / Absorption and wavelength of light changes, the Phenomenon is known as Spectral Shift.

→ we know, different compounds can absorbs different amounts of light and show different wavelength

→ V
I
B
G
Y
O
R





Shift Types

- → hyperchromic - Increasing energy of the substance
- → hypochromic - Decrease in Energy of the substance
- → Bathochromic shift - Increase in wavelength.
- → Hypochromic shift - Decrease in wavelength

☆ Increase in wavelength known as Red shift
☆ Decrease in wavelength known as Blue shift.

#SOLVENT EFFECT ON ABSORPTION SPECTRA

Shift in Wavelength (λmax)

- The maximum absorption of solute can shift depending on solvent used.
- This phenomenon is Referred as "solvent effect".

Change in Intensity :-

- Polar Solvent can absorb Longer wavelength, give Red Shift.
- Non Polar solvent show Shorter wavelength, give Blue Shift.

Beer's Lambert Law

★ Beer's Law - Absorption is directly proportional to the concentration of particle present in sample

Absorption ∝ concentration of particles in sample	— (1)

Or

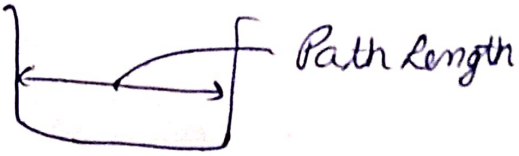
$A \propto C$	— (1)

★ Lambert's Law :- Light Absorption is directly proportional to path length on which light travels in sample.

Absorption ∝ Path length covered by light

Or

$A \propto L$	— (2)



Acc. to Beer's Law & Lambert's Law.

$A \propto C$
$A \propto L$ } — $A \propto CL$

$A \propto C.L$

$\boxed{A = \varepsilon CL}$ Beer's Lambert Law

A = Absorption

ε = Epsilon (Absorption coeff.)

C = Concentration

L = Length

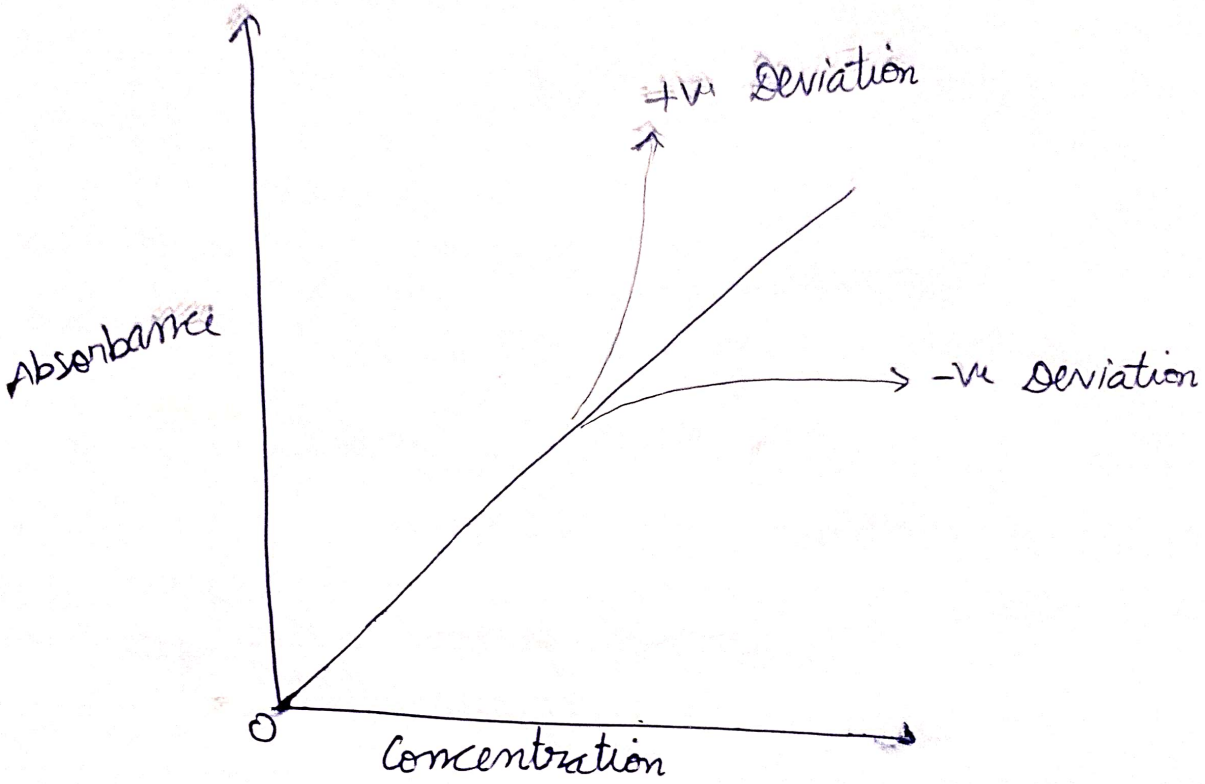
Acc. to Beer's Lambert Law, Absorption is directly proportional to the concentration of solution and the path length

Deviation of Beer's Lambert Law

According to Beer's Law, there is a relationship between Absorbance and concentration.

* Deviation
  - → +ve Deviation
  - → -ve Deviation

⇒ Deviation form non-linear relationship, indidate the failure of Beer's Law.



* ↑se in Absorbance result in +ve Deviation.
* ↑se in Deviation may be due to Increase in Particle Size and number.
* ↓se in Absorbance result in -ve Deviation.
* ↓se in Absorbance may be due to ↓se in Particle size

⇒ Due to Deviation, the graph plotted between concentration and Absorbance is non-linear graph.