Visible Spectroscopy

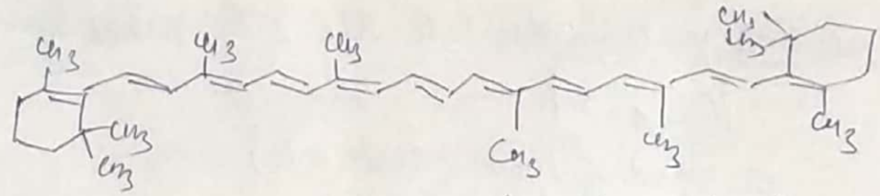
⇒ 400-750 nm range is visible.
⇒ Light waves with wavelengths b/w these limits appears colored to human eye.

λ - 400 nm = violet
λ - 750 nm = red -

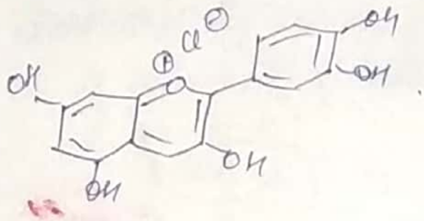
⇒ If a substance absorbs visible light, it appears to have a color, if not, it appears white.
⇒ Inverse relationship b/w observed color & color absorbed.
⇒ A light source emitting violet light emits light at the high energy end of the visible spectrum. A light source emitting red light emits light at the low-energy end of the spectrum.
⇒ The color that our eyes perceives is not the color corresponding to the wavelength of the light absorbed but its complement.
⇒ When the white light falls on the object, light of a particular wavelength is absorbed. The remainder of light is reflected. The eye register all of the reflected light as the color complementary to the color that was absorbed.
⇒ In the case of transparent object a soln the eye receives the light that is transmitted.

Relation b/w absorbed & observed light

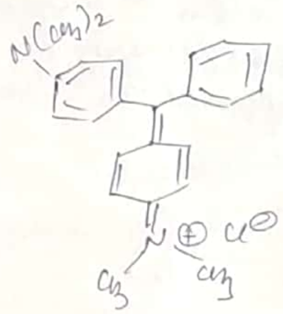
Colour of light observed	λ of light absorbed	observed colour.
Violet	400	Yellow
Blue	450	Orange
Blue-green	500	Red
Yellow-green	530	Red-violet
Yellow	550	Violet
Orange-Red	600	Blue-green
Red.	700	green.



β-Cerotene (Carotenoid) - Orange-
λ max = 452nm.



cyanidinchloride (anthocyanin)
λmax = 545nm - blue.



Malachite green - Green
(triphenylmethane dye)
λmax = 617nm.

⇒ Light:-

- Light composed of electromagnetic waves that travel through some medium.
- the properties of medium determine how light travels through it.
- speed of light in vaccum = 3 x10⁸ m/s (186,000 miles/sec)

⇒ Speed of light denote by 'c'.

⇒ light behaves as a wave so we can describe it one of 2 ways - by its wavelength or by its frequency.

⇒

λ = Wavelength - dist b/w 2 adjacent wave crests. has unit of distance (nm)

ν = frequency - how many times the wave goes up & down in a period of time. has unit of inverse time (1/s = Hz)

So by the relation, you can calculate the 3rd quantity.

$$C = \lambda \cdot \nu$$

C = speed of light (3×10^8 m/s)

λ = wavelength (m)

ν = frequency (s^{-1})

⇒ A particle of light is called a photon.

⇒ The Energy of light can be determined either from the wavelength or frequency,

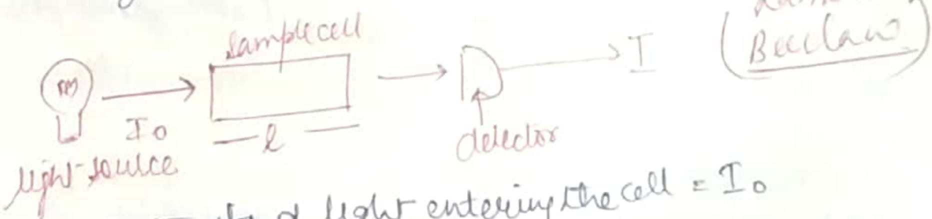
$$E = \frac{hc}{\lambda} \quad \text{or} \quad E = h\nu$$

where h = Planck const

$= 6.626 \times 10^{-34}$ Js

⇒ Absorption or emission of light in UV & vis region involves movement of e⊖ in the atom or molecule.

⇒ One reason UV light is so damaging is light has enough E to break chemical bond present in biological and chemical systems.

⇒ 

Intensity of light entering the cell = I_0

light reflected = I

⇒ The Intensity of light passing through the sample cell for that wavelength (I) is also measured; if I is less than Io, then the sample has absorbed some of the light.

The absorbance (A) of transition depends on 2 factors :-

a) A is directly proportional to c (conc of soln)

b) A is directly proportional to light path (l)

a) $A \propto C$ &

b) $A \propto l$

⇒ The absorbance (A) is defined via incident intensity Io & transmitted intensity (I) by

$$A = \log_{10}\left(\frac{I_0}{I}\right)$$

Now

$$A \propto Cl$$

$$A = \epsilon Cl$$

where ϵ = proportionality const.

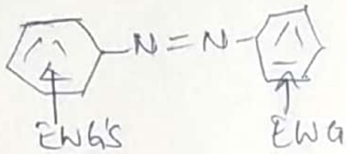
therefore

$$A = \log_{10}\left(\frac{I_0}{I}\right) = \epsilon Cl$$

ϵ = also called molar absorptivity or molar extinction coefficient.

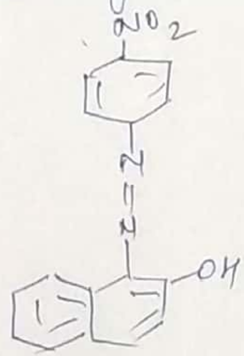
ϵ is a measure of probability of electronic transition.

One of the most common class of coloured cmpds/organic molecule are azo dyes.

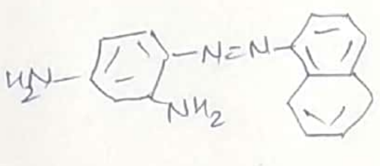


From our discussion of di-substituted aromatic chromophores, the effect of opposite groups is greater than the sum of the individual effects - more so on this heavily conjugated system.

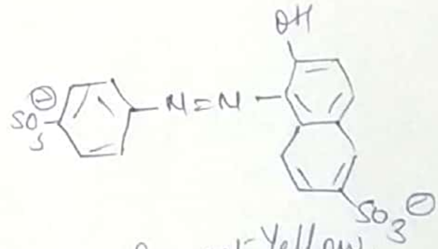
Some are given below:-



para-Red



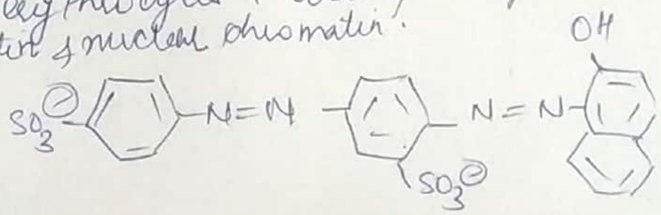
fast Brown



Sunset Yellow.

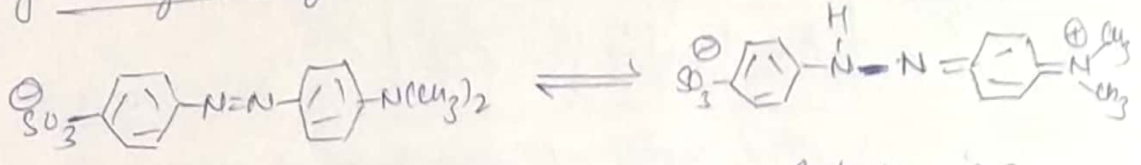
⇒ In biological science these cmpds are used as dyes to selectively stain different tissues or cell struct.

⇒ Biebrich Scarlet :- Used with picric acid/aniline blue for staining collagen, reticulum, muscle and plasma. Luna's method for erythrocytes & eosinophil granules. Guard's method for sex chromatin & nuclear chromatin.



⇒ Also in the chemical science there are acid base indicators used for various pH ranges.
(pH effects on aromatic substituents).

e.g Methyl Orange



yellow, pH > 4.4

Red, pH < 3.2.