Photochemistry

1. Reaction occured in the presence of ultraviolet and visible light. (पराबैंगनी (200-400) व दृश्य प्रकाश (400-800nm))

Eg. photosynthesis (प्रकाश संश्लेषण), Vision etc.

$$6CO_2 + 6H_2O \xrightarrow[\text{Chlorophyll}]{h\nu} C_6H_{12}O_6 + 6O_2$$

* photochemistry is a branch of chemistry which deals with the rate and mechanism of reactions taking place due to exposure to the light.

Laws of Photochemistry:

1) Grotthus - Draper's Law -
   - I st law of photochemistry
   - Given by Grotthus and Draper (1818)
   - Based on qualitative and quantitative studies

* photochemical reactions केवल उन्हीं radiations से होती है जो Substances द्वारा absorbed होती है।

- If light of a particular wavelength is not absorbed by a system, no photochemistry will occur, no matter how long the substance remain under radiations.

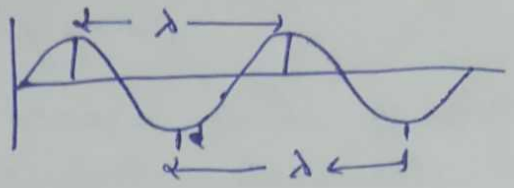
λ_{max} :- Each substance show strongest wavelength towards a particular wavelength known as λ_{max} (maximum λ)

* So, substance, λ_{max} वाला radiation ही absorb करेगा और उसी absorbed light से ही reaction होगी।

- But Vice-versa is not true. i.e. not all absorbed radiations bring the chemical change.

यह आवश्यक नहीं है कि सदैव अवशोषित प्रकाश से अभिक्रिया होती है। कई बार अभिक्रिया नहीं होती है।

Ex. $K_2Cr_2O_7$ soluⁿ absorbs some radiations but no reactions occured and these radiations may convert into heat or light energy of different λ.



- it is a qualitative law → no relation b/w absorbed light and number of reactant molecule.
- Also known as principle of photochemical Activation.

"प्रकाश - रासायनिक सक्रियण का सिद्धान्त"

Law of photo-chemical Equivalence or Stark-Einstein's Law

प्रकाश - रासायनिक तुल्यता का नियम / स्टार्क - आईस्टाइन नियम

- second fundamental law
- given by stark and Einstein (1912)
- Based on quantitative study and quantum theory

* प्रकाश - रासायनिक प्रक्रम में के प्रथम चरण में क्रियाकारी पदार्थ का प्रत्येक अणु एक फोटॉन के अवशोषण द्वारा सक्रियित होता है।

In the Iˢᵗ step of ~~photochem~~ reacⁿ each molecule of reactant absorbs a ~~food~~ photon to get activated.

- Means, each molecule gets activated by absorption of photon.

$$A \xrightarrow{h\nu} A^*$$ (* = activation)

- But this A^* activated molecule (उत्तेजित अणु) does not necessarily gives the product.

अणु फोटोन अवशोषित करके उत्तेजित होता है पर आवश्यक नहीं कि वह उत्पाद बनाये

Hence, this law is also known as principle of quantum activation.

$$E = N h\nu \text{ erg अर्ग}$$

E = absorbed energy / mole

N : Avogadro Number आवोगाड्रो संख्या (6.023×10^{23})

h : Plank's Constant (6.625×10^{-27} erg-sec)

ν : Frequency (cps cycle/sec.)

$\nu = c/\lambda$ c = speed of light (3×10^{10} cm/s)

λ - Wavelength of absorbed light

$$E = N h \frac{c}{\lambda} \text{ erg}$$

$$= \frac{6.023 \times 10^{23} \times 6.625 \times 10^{-27} \times 3.0 \times 10^{10}}{\lambda} \text{ erg}$$

$$\frac{119.70 \times 10^{-6}}{\lambda} \text{ erg}$$

$$\frac{119.70 \times 10^{-6}}{\lambda \times 4.185 \times 10^{7}} \text{ calories}$$

$$E = \frac{2.859}{\lambda} \text{ calories.}$$ Here λ is in cm

if λ in Angstrom $1 \text{ Å} = 10^{-8}$ cm

Then

$$E = \frac{2.859}{\lambda \times 10^{-8}} \text{ cal./mole}$$

$$= \frac{2.859}{\lambda} \times 10^{5} \text{ K.cal/mole}$$

* Energy of one photon = one quantum [hν]

Einstein :- The energy (E) in one mole of photon.

one mole - photon = 6.023×10^{23} photon's Energy

↳ Avogadro Number.

1 Einstein :- Energy of 6.023×10^{23} photons.

1 eV = 1.6×10^{-19} Coulomb × 1 Volt =

1.6×10^{-19} Joule