Photochemistry

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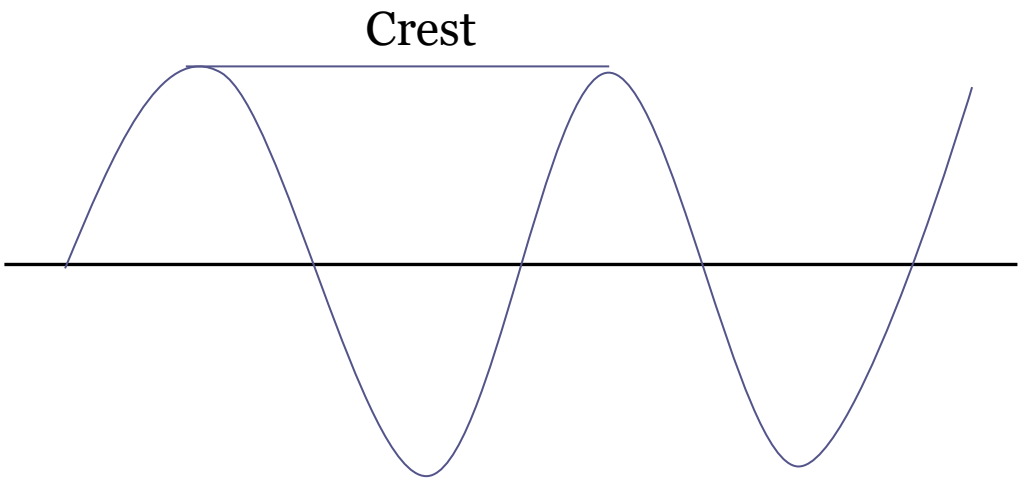
- **Photochemistry is the study of the chemical reactions and physical changes that result from interactions between matter and visible or ultraviolet light.**
- **Chemical reaction caused by absorption of ultraviolet (wavelength from 100 to 400 nm), visible light (400–750 nm) or infrared radiation (750–2500 nm).**
- **Photochemical reactions proceed differently than temperature-driven reactions.**
- **According to the quantum theory, light is also quantised. The absorption or emission of light occurs by the transfer of energy as photons . These photons have both wavelike and particle - like properties and each photon has a specific energy, E, given by Planck ' s law :**

$$E = h\nu$$

A graphical representation of how an electromagnetic radiation travels. Both electric and magnetic components are perpendicular to each other



The distance between two crests is known as wavelength.

One cycle is the number of waves lying between two successive crests. The frequency ν of the wave is the number of cycles passing a given point per unit time.

The unit of wavelength λ is 'm' and that of frequency is hertz (H).

$E = hc/\lambda = h\nu$ where c is the velocity of light and h is Planck's Constant.

Three basic processes of light – matter interaction

1. During the absorption of light, a photon having energy equal to the energy difference between two electronic states uses the available energy to shift an electron from the lower energy level to the upper one, generating an electronically - excited state.

- The photon is completely consumed in the process and the energy of photon becoming part of the total energy of the absorbing species.
- This gives rise to two basic laws of photochemistry:

1. Grotthhus-Draper law
2. The Stark-Einstein effect.

- Grotthuss-Draper Law states that only light which is absorbed by a molecule can bring about photochemical change in the system.
- The Stark – Einstein law states that the primary act of light absorption by a molecule is a one - quantum process. That is, for each photon absorbed only one molecule is excited. This law is obeyed in the vast majority of cases but exceptions occur when very intense light sources such as lasers are used for irradiation of a sample. In these cases, concurrent or sequential absorption of two or more photons may occur.

2) On irradiation with electromagnetic radiation, there may be spontaneous emission and an excited atom or molecule emits a photon of energy equal to the energy difference between the two states without the influence of other atoms or molecules. The photons that are produced out of the phase with each other. The light emitted is incoherent one.

3) Stimulated emission occurs when a photon of energy equal to the energy difference between the two states interacts with an excited atom or molecule. The photons produced by stimulated emission are in phase with the stimulating photons and travel in the same direction; that is, the light produced by stimulated emission is coherent light .