Organic Chemistry

B.Sc II Year [Paper-II]

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Dr. Danveer Singh Yadav

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Preface

Organic Chemistry is the study of the compounds of carbon, their reactions and their preparation. It is a fundamental course for the life sciences and chemical engineering. Traditionally, it is presented as a description of a large number of compounds classified by structure, and a few hundred typical reactions that will show how they can be prepared, and how they behave with respect to one another. This constitutes a very large amount of empirical information that is usually committed to memory as a sort of mental handbook, supplemented by actual handbooks, and by laboratory practice with a relatively small number of important or illustrative general reactions. It is unusually difficult to assimilate this mass of information because of the lack of a general pattern (only empirical rules) and heuristic aids.

Different molecules absorb radiation of different wavelengths. An absorption spectrum will show a number of absorption bands corresponding to structural groups within the molecule. For example, the absorption that is observed in the UV region for the carbonyl group in acetone is of the same wavelength as the absorption from the carbonyl group in diethyl ketone.

Many inorganic species show charge-transfer absorption and are called charge-transfer complexes. For a complex to demonstrate charge-transfer behaviour, one of its components must have electron donating properties and another component must be able to accept electrons. Absorption of radiation then involves the transfer of an electron from the donor to an orbital associated with the acceptor.

Spectrum, rainbowlike series of colours, in the order violet, blue, green, yellow, orange, and red, produced by splitting a composite light, such as white light, into its component colours. Indigo was formerly recognized as a distinct spectral colour. The rainbow is a natural spectrum, produced by meteorological

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phenomena. A similar effect can be produced by passing sunlight through a glass prism.

The boiling points of carboxylic acids are the high because of the hydrogen bonding involved in the hydroxyl group. Carboxylic acids have higher boiling points than alcohols of the same number of carbons. The solubilities of carboxylic acids are very similar to the alcohols. Both families have molecules that are polar.

Organic chemistry is a specific discipline within the subject of chemistry. It is the scientific study of the structure, properties, composition, reactions, and preparation (by synthesis or by other means) of chemical compounds of carbon and hydrogen, which may contain any number of other elements, such as nitrogen, oxygen, halogens, and, more rarely, phosphorus or sulfur.

The book is comprehensive and clearly explains the basic principles in a lucid and concise manner. The book provides an excellent high level as well as detailed presentation of topics that are often difficult for students to master.

—Dr. Danveer Singh Yadav

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1

Electromagnetic Spectrum Absorption Spectra

ULTRAVIOLET (UV) ABSORPTION SPECTROSCOPY

Many molecules absorb ultraviolet or visible light. The absorbance of a solution increases as attenuation of the beam increases. Absorbance is directly proportional to the path length, *b*, and the concentration, *c*, of the absorbing species. *Beer's Law* states that

$A = \varepsilon bc$, where ε is a constant of proportionality, called the *absorbtivity*.

Different molecules absorb radiation of different wavelengths. An absorption spectrum will show a number of absorption bands corresponding to structural groups within the molecule. For example, the absorption that is observed in the UV region for the carbonyl group in acetone is of the same wavelength as the absorption from the carbonyl group in diethyl ketone.

Electronic transitions

The absorption of UV or visible radiation corresponds to the excitation of outer electrons. There are three types of electronic transition which can be considered;

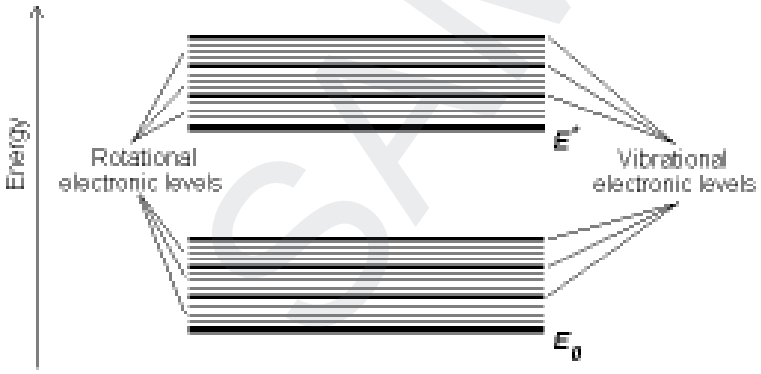
1. Transitions involving π, σ, and n electrons
2. Transitions involving charge-transfer electrons

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3. Transitions involving *d* and *f* electrons (not covered in this Unit)

When an atom or molecule absorbs energy, electrons are promoted from their ground state to an excited state. In a molecule, the atoms can rotate and vibrate with respect to each other.

These vibrations and rotations also have discrete energy levels, which can be considered as being packed on top of each electronic level.



Absorbing species containing π, σ, and n electrons

Absorption of ultraviolet and visible radiation in organic molecules is restricted to certain functional groups (*chromophores*) that contain valence electrons of low excitation energy. The spectrum of a molecule containing these chromophores is complex. This is because the superposition of rotational and vibrational transitions on the electronic transitions gives a combination of overlapping lines. This appears as a continuous absorption band.

Possible *electronic* transitions of π, σ, and *n* electrons are;

σ → σ* Transitions

An electron in a bonding σ orbital is excited to the corresponding antibonding orbital. The energy required is large. For example, methane (which has only C-H bonds, and can only undergo $\sigma \rightarrow \sigma^*$transitions) shows an absorbance maximum at 125 nm. Absorption maxima due to $\sigma \rightarrow \sigma^*$ transitions are not seen in typical UV-Vis. spectra (200 - 700 nm)

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