Ministry of Higher Education and Scientific Research

Al-Muthanna University

Organic chemistry

For the 1st year students of the «faculty of Pharmacy»

Lecture (1)
Introduction to organic chemistry

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Organic
Chemistry

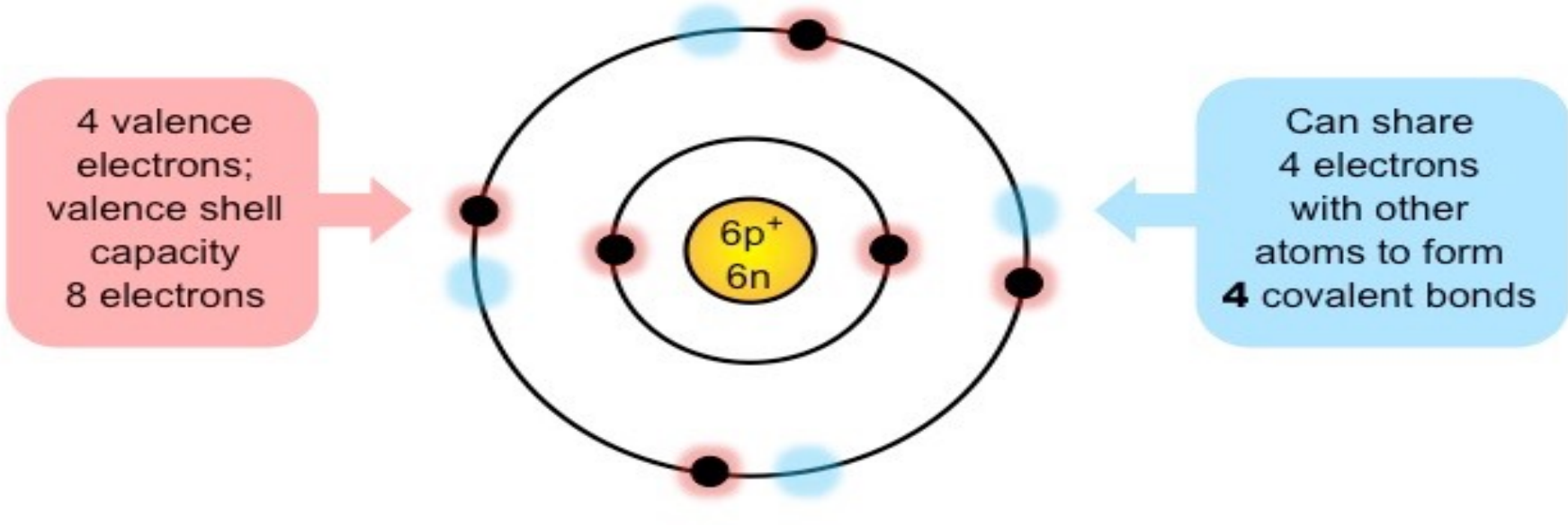
Organic chemistry is the chemistry of hydrocarbons and their derivatives.

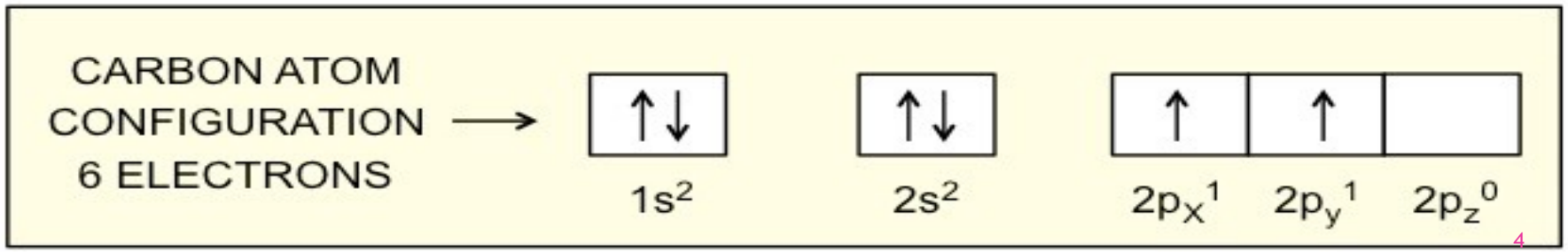
An organic compound is a compound that contains carbon and is found in *living things*
Exceptions include carbides (e.g. CaC_2), carbonates (CO_3^{2-}), oxides of carbon (CO, CO_2) and cyanides (CN^-)

Carbon:

- Carbon atom can form *four* covalent bonds, with bonds between carbon atoms being particularly stable.
- These properties allows carbon to form a wide variety of organic compounds that are chemically stable.

Schematic of a Carbon Atom





A carbon atom in an excited state is capable of:
1) form strong bonds with other carbon atoms, which leads to the formation of chains and cycles

2) due to the different types of hybridization orbitals to form single, double and triple bonds between carbon atoms and with other atoms (H, O, S, N, P and etc.)

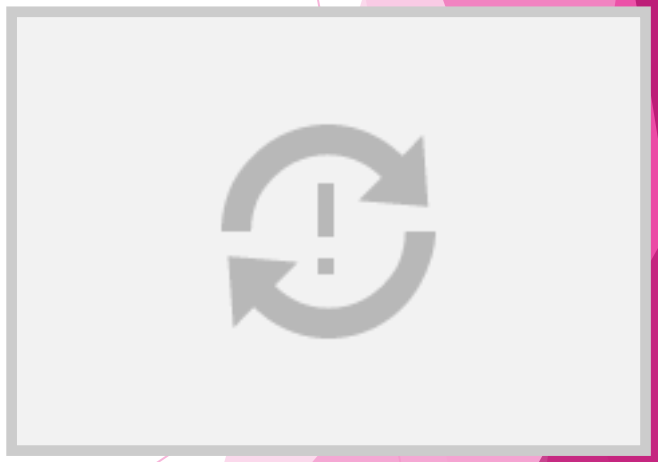
3) combine with four different atoms, resulting in the formation of branched carbon chains.

Hybridization of Carbon

- **Hybridization of Carbon** – Carbon is one of the important and most common chemical element that is essential for organic connections. Carbon atoms usually form bonds by mixing different orbitals and can contribute to the formation of different structures and properties.
- when we talk about the hybridization of carbon, there are several types. Most of the time the s and p orbitals of the second shell in carbon combine together during hybridization. Carbon can use different hybridization to form different compounds.

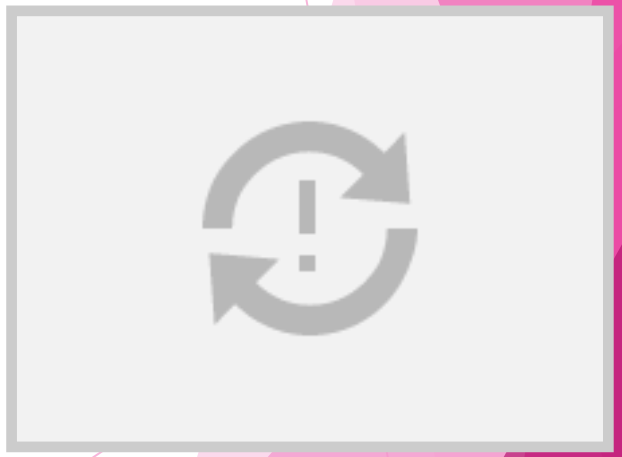
1. sp^3 Hybridization

- When the carbon atom is bonded to four other atoms the hybridization is said to be sp^3 type. Here 1 s orbital and 3 p orbitals in the same shell of an atom combine to form four new equivalent orbitals. ***There is a formation of single bonds*** **.**The arrangement is tetrahedral with a bond angle of 109.5°.



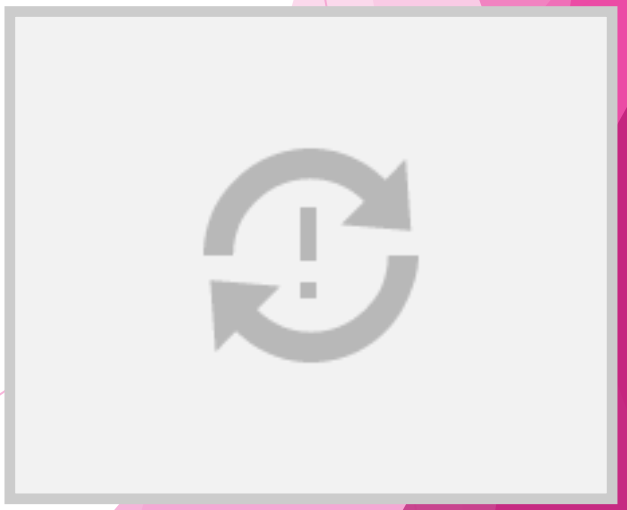
2. sp^2 Hybridization

- A carbon atom is sp^2 hybridized when bonding takes place between 1 s-orbital with two p orbitals. There is *a* ***formation of two single bonds and one double bond between three atoms***. The hybrid orbitals are placed in a triangular arrangement with 120° angles between bonds.



3. sp Hybridization

- Carbon can have an sp hybridization when ***it is bound to two other atoms with two double bonds*** **or** ***two atoms with one triple bond and one single bond***. When the hybridization occurs the molecules have a linear arrangement of the atoms with a bond angle of 180°.



organic molecule

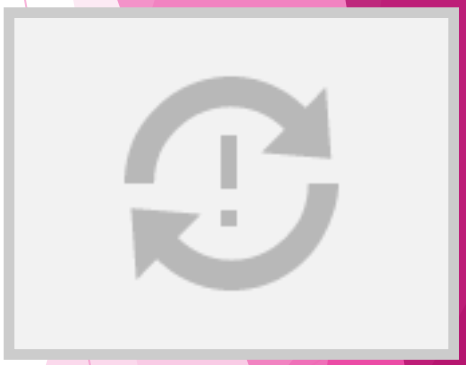
carbon chain atoms
carbon skeleton

+

Functional Group
identifies the classes of
organic compounds

Types of the carbon skeleton :

- normal
  - Linear
  - Branched
- Acyclic
  - carbocyclic (cycle of only carbon atoms);
  - heterocyclic (except carbon atoms in the cycle includes several other atoms - nitrogen , oxygen, sulfur) .

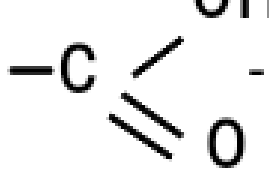




Functional group is a special group of atoms, which determines the chemical properties of the compounds.

Examples of functional groups:

-OH – hydroxyl group (alcohols, phenols);

>C=O – carbonyl group (ketone, aldehyde);

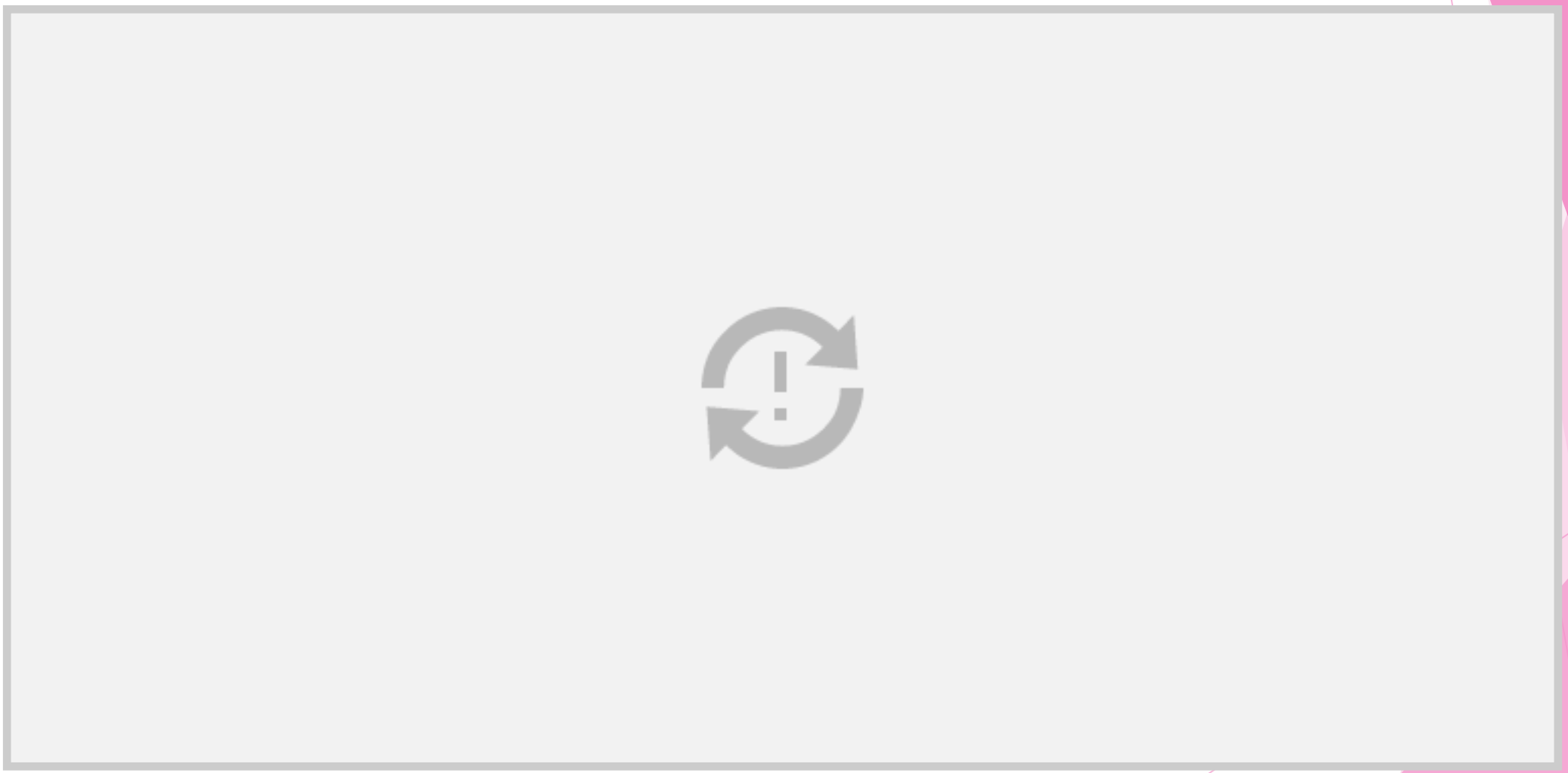


- A carboxyl group (carboxylic acid);

$-NH_2$ – Amino group (amine);

-SH – Thiol group (thioalcohols)

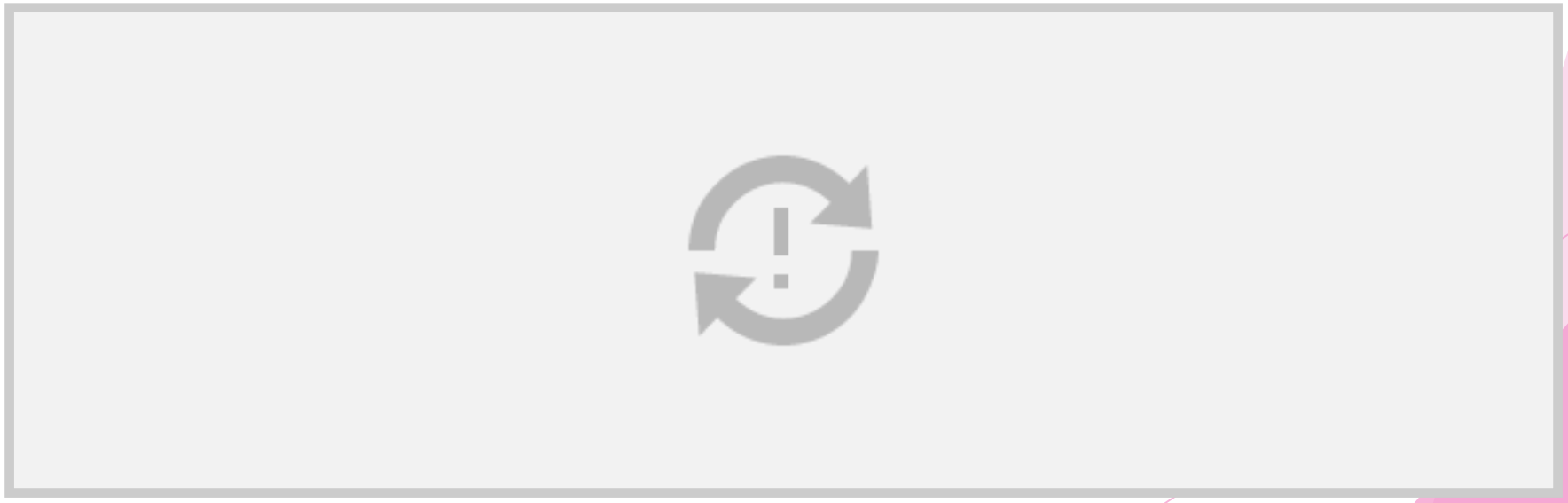
Isomers: compounds with the same molecular formula but different structure (arrangement of atoms)



1- Structural Isomerism

A) Chain Isomerism

- It is also known as skeletal isomerism.
- The components of these isomers display differently branched structures.
- chain isomers differ in the branching of carbon
- An example of chain isomerism can be observed in the compound C_5H_{12},



B) Position Isomerism

- The positions of the functional groups are different in position isomers.
- This isomerism involves the attachment of the functional groups to different carbon atoms in the carbon chain.
- An example of this type of isomerism can be observed in the compounds having the formula C_3H_7Cl.

C) Functional Isomerism

- As the name suggests, it refers to the compounds that have the same chemical formula but different functional groups attached to them.
- An example of functional isomerism can be observed in the compound C_3H_6O.

2. Stereoisomerism

A) Geometric Isomerism

- It is known as cis-trans isomerism.
- These isomers have different spatial arrangements of atoms in three-dimensional space.
- An example describing the geometric isomerism observed in the acyclic

2-Butene molecule

B)Optical Isomerism


Best Regards!
Thank you!