الكلية	كلية التربية للعلوم الصرفة
القسم	قسم الكيمياء
المادة باللغة الانجليزية	Organic chemistry
المادة باللغة العربية	الكيمياء العضوية
المرحلة الدراسية	المرحلة الثانية
اسم التدريسي	د. عمر جمال مهدي العسافي
عنوان المحاضرة باللغة الانجليزية	***Functional Groups***
عنوان المحاضرة باللغة العربية	المجاميع الوظيفية
رقم المحاضرة	الاولى
المصادر والمراجع	***Organic Chemistry*** 6ed , William H. Brown, Christopher S. Foote, Brent L. Iverson, Eric V. Anslyn, Bruce M. Novak, 2012
	Organic Chemistry 3ed , Janice Gorzynski Smith, 2011
	Organic Chemistry" by Jonathan Clayden, Nick Greeves, and Stuart Warren

Functional Groups

What are the characteristic features of an organic compound? Most organic molecules have C– C and C – H σ bonds. These bonds are strong, nonpolar, and not readily broken. Organic molecules may have the following structural features as well:

•Heteroatoms—atoms other than carbon or hydrogen. Common heteroatoms are nitrogen, oxygen, sulfur, phosphorus, and the halogens.

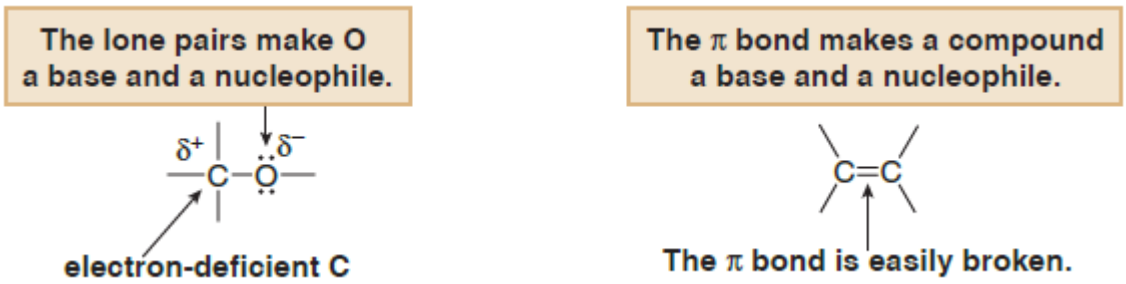
•p Bonds. The most common π bonds occur in C – C and C – O double bonds.

These structural features distinguish one organic molecule from another. They determine a molecule's geometry, physical properties, and reactivity, and comprise what is called a functional group.

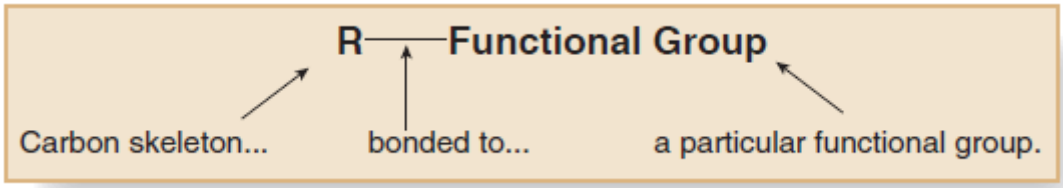
A functional group is an atom or a group of atoms with characteristic chemical and physical properties. It is the reactive part of the molecule.

Why do heteroatoms and π bonds confer reactivity on a particular molecule?

- **Heteroatoms have lone pairs and create electron-deficient sites on carbon.**
- **π Bonds are easily broken in chemical reactions. A π bond makes a molecule a base and a nucleophile.**



Don’t think, though, that the C – C and C – H σ bonds are unimportant. They form the carbon backbone or skeleton to which the functional groups are bonded. A functional group usually behaves the same whether it is bonded to a carbon skeleton having as few as two or as many as 20 carbons. For this reason, we often abbreviate the carbon and hydrogen portion of the molecule by a capital letter R, and draw the R bonded to a particular functional group.



We can subdivide the most common functional groups into three types .

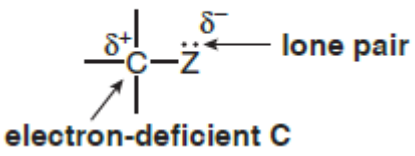
•Hydrocarbons

•Compounds containing a C – Z r bond where Z = an electronegative element

•Compounds containing a C =O group

Compounds Containing C–Z r Bonds

Several types of functional groups that contain C – Z σ bonds are listed in Table below . The electronegative heteroatom Z creates a polar bond, making carbon electron deficient. The lone pairs on Z are available for reaction with protons and other electrophiles, especially when Z = N or O.



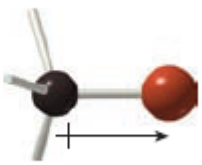
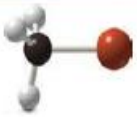


Table Compounds Containing C–Z σ Bonds

Type of compound	General structure	Example	3-D structure	Functional group
Alkyl halide	R—$\ddot{X}$: (X = F, Cl, Br, I)	CH_3—$\ddot{Br}$:		–X halo group
Alcohol	R—$\ddot{O}$H	CH_3—$\ddot{O}$H		–OH hydroxy group
Ether	R—$\ddot{O}$—R	CH_3—$\ddot{O}$—CH_3		–OR alkoxy group
Amine	R—$\ddot{N}H_2$ or $R_2\ddot{N}H$ or $R_3\ddot{N}$	CH_3—$\ddot{N}H_2$		–NH_2 amino group
Thiol	R—$\ddot{S}$H	CH_3—$\ddot{S}$H		–SH mercapto group
Sulfide	R—$\ddot{S}$—R	CH_3—$\ddot{S}$—CH_3		–SR alkylthio group

Compounds Containing a C=O Group

Many different types of functional groups possess a C -O double bond (a carbonyl group), as shown in Table. The polar C-O bond makes the carbonyl carbon an electrophile, while the lone pairs on O allow it to react as a nucleophile and base. The carbonyl group also contains a π bond that is more easily broken than a C-O σ bond.

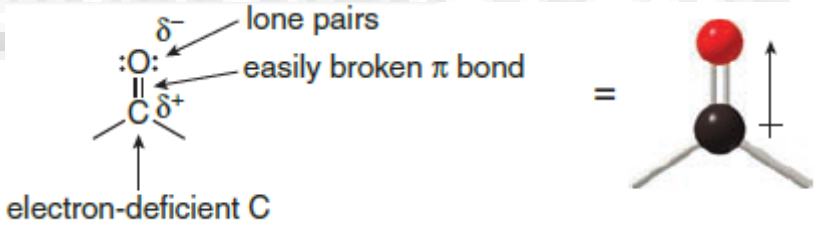
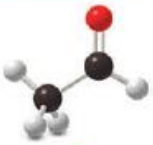
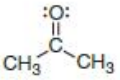
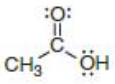
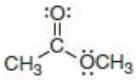
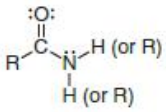
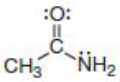
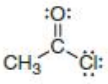


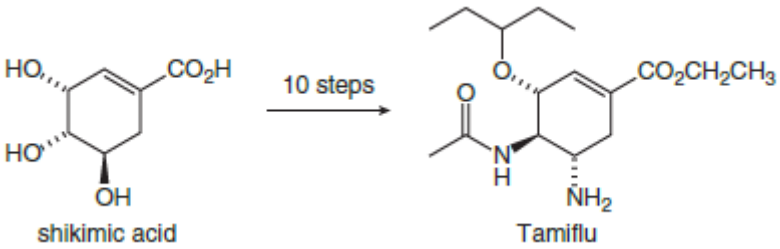
Table Compounds Containing a C=O Group

Type of compound	General structure	Example	3-D structure	Functional group
Aldehyde				C=O carbonyl group
Ketone				C=O carbonyl group
Carboxylic acid				−COOH carboxy group
Ester				−COOR
Amide				$-CONH_2$, −CONHR, or $-CONR_2$
Acid chloride				−COCl

A functional group determines all the following properties of a molecule:

- bonding and shape
- type and strength of intermolecular forces
- physical properties
- nomenclature
- chemical reactivity

Problem -: Identify the functional groups in Tamiflu and shikimic acid.



shikimic acid Tamiflu

Problem Draw the structure of a compound fitting each description:

a. An aldehyde with molecular formula C4H8O

b. A ketone with molecular formula C4H8O

c. A carboxylic acid with molecular formula C4H8O2