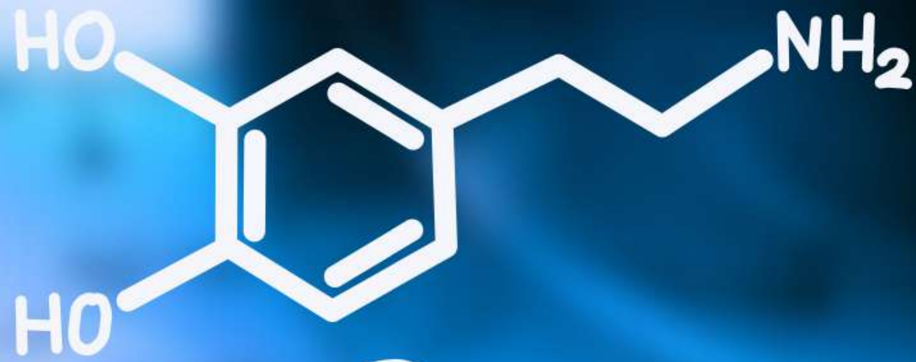
لجان الدُّفعات

DOPAMINE ACADEMY

Organic 1



Dopamine

Subject: Lecture (1+2)

Student Name: Razan Abdullah

25-7-2024

Pharmaceutical Organic Chemistry-1

Chapter-1: Introduction

Organic Chemistry: Definition

- The word **Organic** can be a biological or chemical term, in biology it means anything that is living or has lived. The opposite is Non-Organic.
- **Organic Chemistry** is unique in that it deals with vast numbers of substances, both natural and synthetic.

مطاط طلاء

The clothes, the petroleum products, the paper, rubber, wood, plastics, paint, cosmetics, insecticides, and drugs

مبيدات حشرية

- But, from the chemical makeup of organic compounds, it was recognized that one constituent common to all was *the element carbon*. مركب الكربون هو العنصر الأساسي
الداخل في التركيب الكيميائي لجميع المركبات العضوية
- **Organic chemistry** is defined as *the study of carbon/hydrogen-containing compounds and their derivatives.*

The Uniqueness of Carbon

- What is unique about the element *carbon*?
- Why does it form so many compounds?
  - *The answers lie in*
    - ➢ The **structure** of the *carbon* atom.

      توزيع e⁻ الفراغي في الـ C

    - ➢ The **position** of *carbon* in the periodic table.

      موقعه المتوسط في الجدول الدوري
      بين الفلزات (المجموعات ١، ٢، ٣) التي تميل لفقد e⁻ وبين
      اللافلزات (مجموعة ٥، ٦، ٧) التي تميل لكسب e⁻

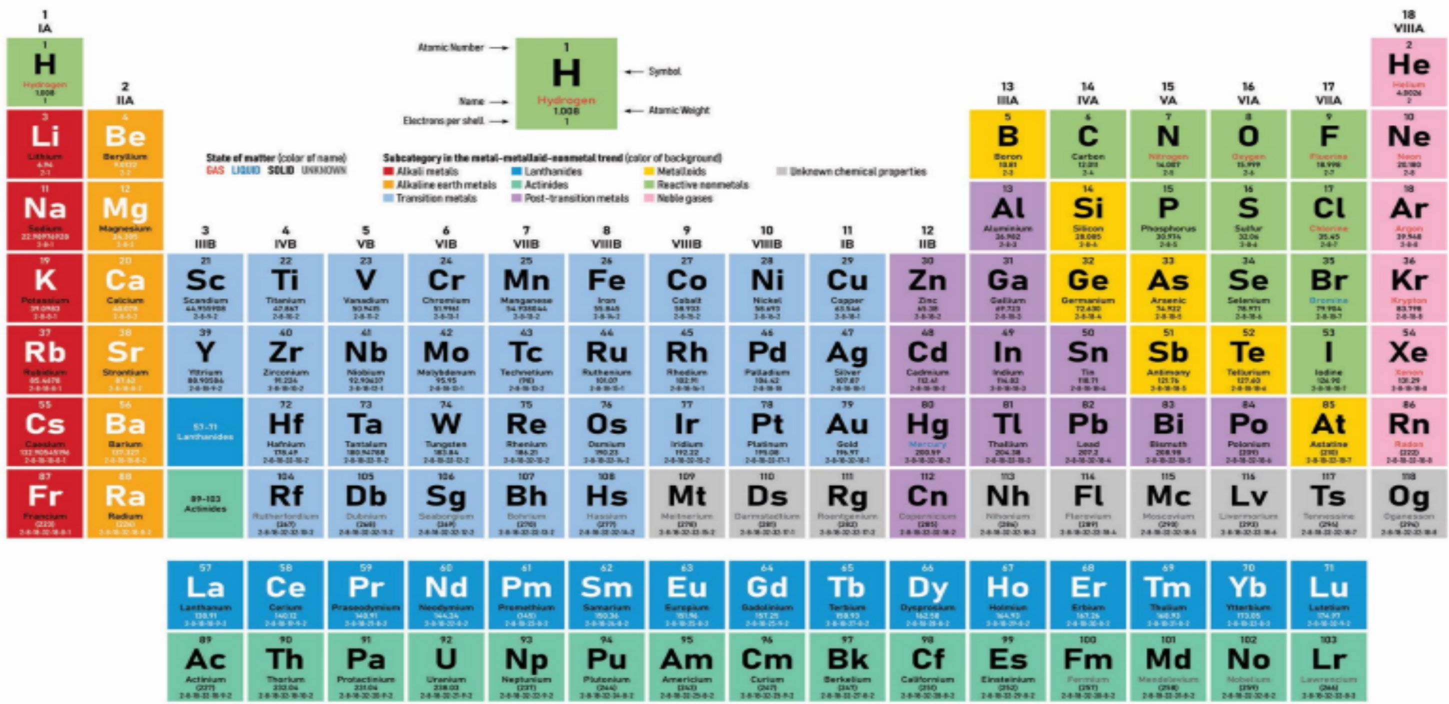
- These factors enable it to form strong bonds with

  يميل C لمشاركة e⁻ التكافؤ التي يملكها
  مكونًا روابط تساهمية

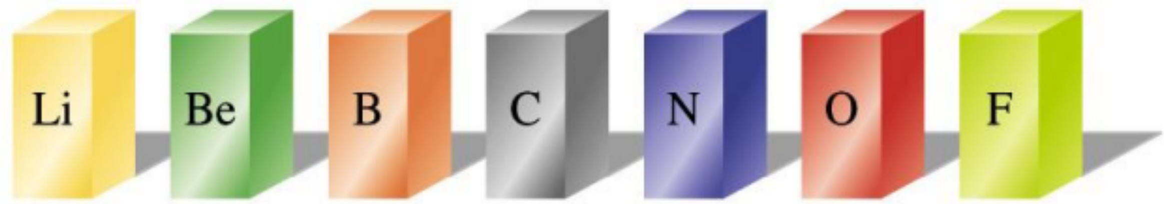
  - ➢ other carbon atoms
  - ➢ and with other elements (hydrogen, oxygen, nitrogen, halogens,…etc).
- Each **organic compound** has its own characteristic set of physical and chemical properties which depend on the *structure of the molecule.*

طريقة ارتباط الـ C بالعناصر الأخرى
سواء C، الهالوجين، … etc ، رح يأثر على
الشكل الفراغي للكربون وبالتالي خصائصه
الفيزيائية والكيميائية

Periodic Table of the Elements



- Organic compounds are compounds containing carbon



the second row of the periodic table

- Atoms to the left of carbon give up electrons.
- Atoms to the right of carbon accept electrons.
- Carbon shares electrons.

Atomic Structure

- **Atoms consist of three main particles: neutrons (have no charge), protons (positively charged) and electrons (negatively charged).**
  - ➢ **Neutrons and protons are found in the nucleus.**
  - ➢ **Electrons are found outside the nucleus.**

    rotating

    Electrons are distributed around the nucleus in successive *shells* (*principal energy levels*).

* موجودة e ب shells مختلفين عشان يخفف التنافر بينهم وكلما زاد عدد e الي بيدور حول ال atom كلما زاد حجمها

- **Atom is electrically neutral.**

  i.e. Number of electrons = Number of protons

- **Atomic number of an element is the number of protons.**

→ عدد البروتونات لأن الذرة ممكن تفقد e او تكسبها لكن عدد البروتونات ثابت

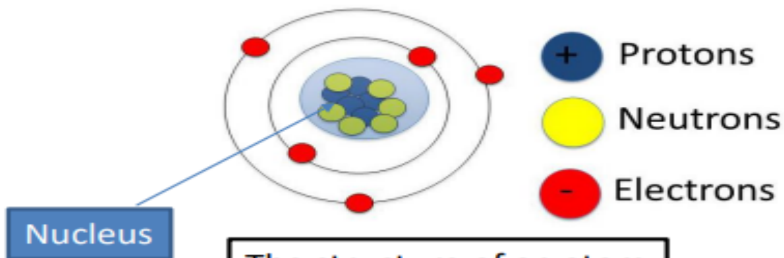
Bonding and Isomerism

1.1 How Electrons Are Arranged in Atoms

يحتفظ

- An atom is: the *smallest particle* of an element that retains all of the chemical properties of that element.

•An atom consists of negatively charged electrons, positively charged protons, and neutral neutrons



The structure of an atom

• **Atomic number**: numbers of protons in its nucleus and it's the number of electrons in the neutral atom.

• **Mass number**: the sum of the protons and neutrons of an atom.
(Protons and neutrons are ~1837 times the mass of an e^-)

•Isotopes have the same atomic number but different mass numbers (^{12}C and ^{13}C)

يختلف عدد النيوترونات

Atomic Structure

- **The energy levels are designated by capital letters (*K*, *L*, *M*, *N*, ..) or whole numbers (*n*).**
- **The maximum capacity of a shell = *2n2* electrons.**

  ***n* = number of the energy level.**

- **For example, the element carbon (atomic number 6)**

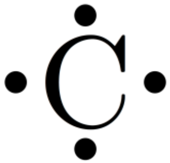
  6 electrons are distributed about the nucleus as

Shell	K	L	M	N
Number of electrons	2	4	0	0

Atomic Structure

Valance Electrons: Electron-Dot Structures

- **Valance Electrons** are those electrons located in the ***outermost energy level*** **(*the valance shell*).**
- **Electron-dot structures**
  - **The symbol of the element represents the core of the atom.**
  - **The valance electrons are shown as dots around the symbol.**



Chemical Bonding

- **In 1916 G.N. Lewis pointed out that:**

  The noble gases were stable elements and he described their lack of reactivity to their having their valence shells filled with electrons.

  - **2 electrons in case of helium.**
  - **8 electrons for the other noble gases.**

- **According to Lewis,**

  in interacting with one another atoms can achieve a greater degree of stability

  by rearrangement of the valence electrons

  to acquire the outer-shell structure of the closest noble gas in the periodic table.

e^- located in the outermost energy level

Chemical Bonding

Covalent bond

non-covalent bond → can restore the first structure

مثال ionic bond في منها كثير أنواع

When two atoms combine together

Of the same element they form a molecule of element	Of different elements they form a molecule of compound.
Ex:	Ex:
O + O → O_2 Oxygen atom + Oxygen atom → Oxygen molecule	Na + Cl → NaCl Sodium atom + Chlorine atom → Sodium chloride molecule
Covalent Bonds	**Ionic Bonds**

* كل ال atoms في ال periodic table هدفهم يوصلو لإستقرار الغازات النبيلة بأنو مدارهم الأخير يكون مشبع

* لو كانت كل ال atoms مشبعه مارح استفيد لأنو حتفقد ال reactivity للعناصر

- sharing e-
- high stable كسرها صعب جداً بالتالي جداً وإذا داخل الجسم مستحيل لأنها بحاجة لكميات كبيرة من الطاقة

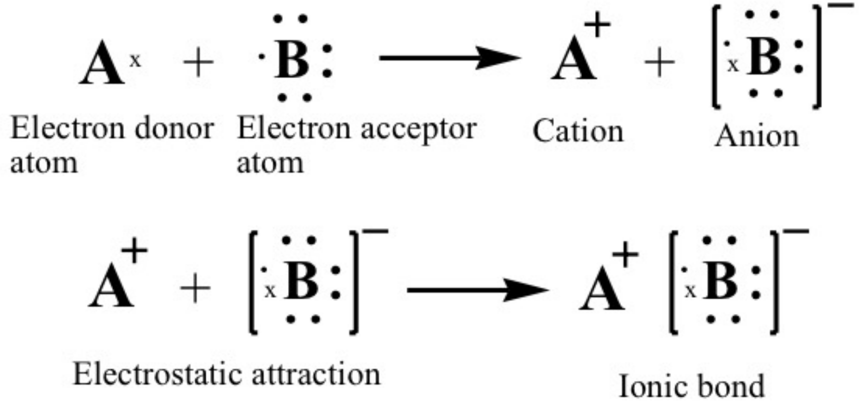
A) Ionic Bonds

- Elements at the left of the periodic table give up their valance electrons and become *+ve charged ions* (*cations*).
- Elements at the right of the periodic table gain the electrons and become *-ve charged ions* (*anions*).

يعني ان قوى الجذب التي تنشأ بين الأيونات مختلفة الشحنة هي التي
تجذب هذه الأيونات لبعضها

- Ionic bond

  The electrostatic force of attraction between oppositely charged ions.



ملاحظة :

$A + B \longrightarrow C$

ما الذي يجعل هذا التفاعل
more forward ؟

ال product (C) يكون more stable
من ناحية energy الخزمن الreactant (A,B)

← وفي حال كان التفاعل ما بمشي بسهولة انا
بضطر اضيف طاقة فسهولة التفاعل إما بسبب
طبيعة اكوار أو انا بضيف طاقة

- The majority of ionic compounds are *inorganic substances*.

Electronegativity Measures The Ability of An Atom To Attract Electrons

more aggresive ← reaction كلما كان ال

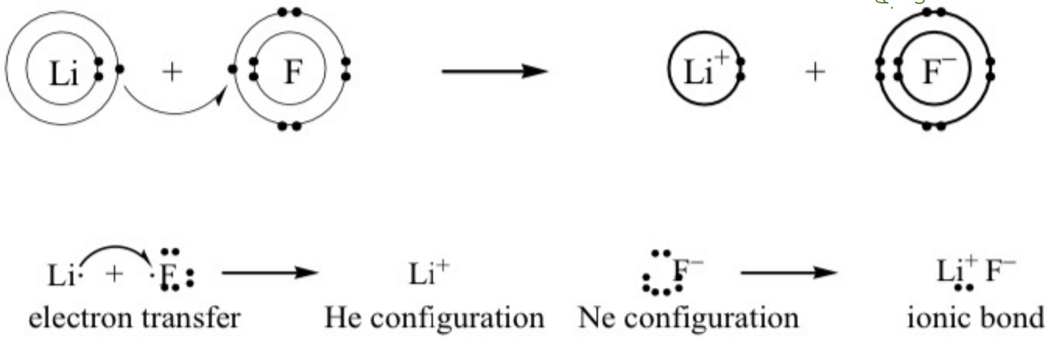
Increasing electronegativity →

H							
2.1							
Li	Be		B	C	N	O	F
1	1.5		2	2.5	3	3.5	4
Na	Mg		Al	Si	P	S	Cl
0.9	1.2		1.5	1.8	2.1	2.5	3
K							Br
0.8							2.8

Decreasing electronegativity ↓

* على الجدول الدوري بتزداد السالبية الكهربائية من الشمال لليمين ومن الأسفل للأعلى

* ذرة F الأعلى سالبية كهربائية (most reactive)
دايما بيتدخل التفاعلات بطريقة عنيفة - لأنها صغيرة الحجم
وحبها لل e^- عالي جدا



B) Covalent Bonds

- **Elements that are close to each other in the periodic table attain the stable noble gas configuration** تكوين

  الرابعة مع الخامسة / الخامسة مع السادسة
  لـ لأنهم متقاربين في القوة بتشاركوا ـه فالمدار
  الأخير لكل ذرة يكون مشبع تماما

  by sharing valence electrons between them.

- **Covalent bond**

  The chemical bond formed when two atoms share one pair of electrons.

- **A shared electron pair between two atoms or single covalent bond, will be represented by a dash (-).**

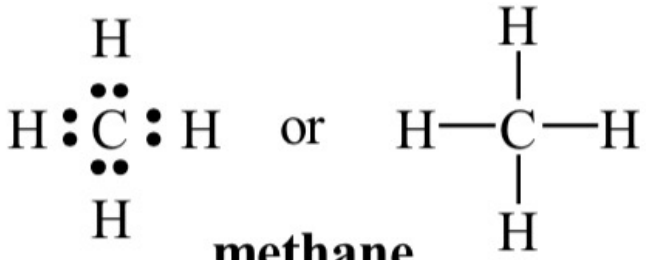
B) Covalent Bonds

Examples

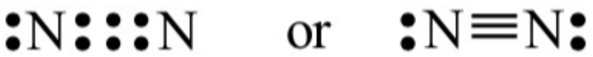
H_2

each H shares two electrons (He configuration)

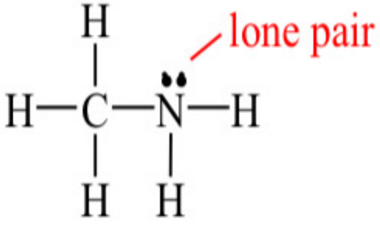
Cl_2



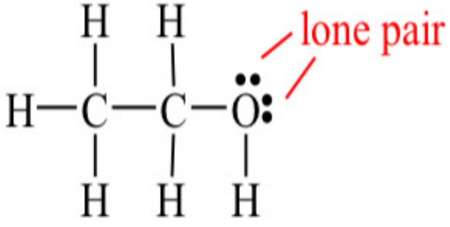
methane



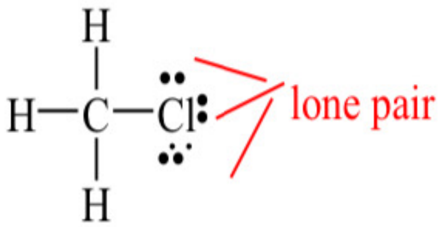
N_2



methyl amime



ethanol



chloromethane

B) Covalent Bonds

- In molecules that consist of two like atoms;

  the bonding electrons are shared equally

  (both atoms have the same electronegativity).

- When two unlike atoms;

  the bonding electrons are no longer shared equally (shared unequally).

A) Polar Covalent Bond

A bond, in which an electron pair is shared unequally.

➢ **The more electronegative atom assumes a partial negative charge and the less electronegative atom assumes a partial positive charge.**

* بناء على valence e^- بصنف
مركباتي حتفقد او تكسب وتفاعلاتها
لمجموعات (١، ٢، ٣، ٥، ٦، ٧)

B) Coordinate Covalent Bonds

- There are molecules in which one atom supplies both electrons to another atom in the formation of a covalent bond.

دون يكون فيه إنتقال كلي للـ e

- For example;

- **Lewis base**

  The species that furnishes the electron pair to form a coordinate covalent bond.

- **Lewis acid**

  The species that accepts the electron pair to complete its valance shell.

- Electrons are located in atomic orbitals (S, P, d, f).
- Orbitals tell us the energy of the electron and the volume of space around the nucleus where an electron is most likely to be found.
- Orbitals are grouped in shells .

Each orbital can hold a maximum of $2e^-$ and the two electrons have opposite spin

Table 1.1 Distribution of Electrons in the First Four Shells That Surround the Nucleus

	First shell	Second shell	Third shell	Fourth shell
Atomic orbitals	*s*	*s*, *p*	*s*, *p*, *d*	*s*, *p*, *d*, *f*
Number of atomic orbitals	1	1, 3	1, 3, 5	1, 3, 5, 7
Maximum number of electrons	2	8	18	32

Valence electrons (VE) are located in the outermost shell. They are involved in chemical reactions.

VE = Group number

		VE	Lewis symbol of atom
Examples:	^{1}H: Is^{1}	1	H·
	^{8}O: $IS^{2}\ 2S^{2}\ 2P^{4}$	6	:Ö:
	^{6}C: ________________________		

Table 1.3 Valence Electrons of the First 18 Elements

Group	I	II	III	IV	V	VI	VII	VIII
	H ·							He :
	Li ·	·Be ·	· Ḃ ·	· Ċ ·	· Ṅ :	· Ö :	: F̤̈ :	: N̤̈e :
	Na ·	·Mg ·	· Ȧl ·	· Ṡi ·	· Ṗ :	· S̈ :	: C̈l :	: Ä̤r :

How Many Bonds to an Atom? Covalence Number

The number of covalent bonds that an atom can form with other atoms.

i.e. *the covalence number is equal to the number of electrons needed to fill its valance shell.*

Element	Number of valence electrons	Number of electrons in filled valence shell	Covalence number
H	1	2	1
C	4	8	4
N	5	8	3
O	6	8	2
F, Cl, Br, I	7	8	1

Shapes of Organic Molecules: Orbital Picture of Covalent Bonds

Atomic Orbitals

يعني العنصر يكون بمفرده وغير مرتبط بمركب آخر

- An atomic orbital *represents a specific region in space in which an electron is most likely to be found.*
- Atomic orbitals are designated in the order in which they are filled by the letters *s, p, d,* and *f*.
  - Examples:

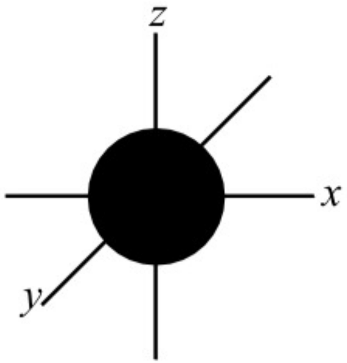
    K shell has only one 1s orbital.

    L shell has one 2s and three 2p ($2p_x$, $2p_y$ and $2p_z$).

  - An *s* orbital is spherically shaped electron cloud with the atom's nucleus and its center.

بال s ← e^- ← يعطيني شكل كروي

بال p ← e^- ← يعطي شكل الجرس المقلوب



s orbital

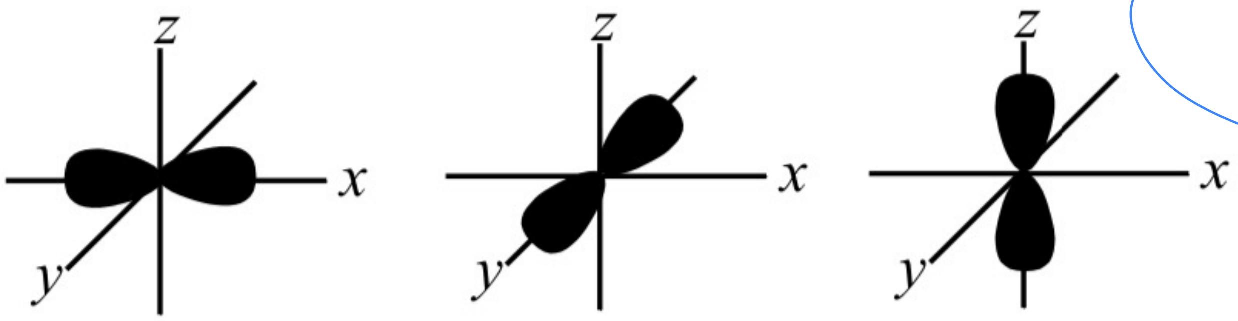
Shapes of Organic Molecules: Orbital Picture of Covalent Bonds

Atomic Orbitals

- A *p* orbital is a dumbbell-shaped electron cloud with the nucleus between the two lobes.

- Each *p* orbital is oriented along one of three perpendicular coordinate axes (in the *x*, *y*, or *z* direction).

* بحاول اخلي ع ابعد مايمكن عن بعضهم عشان اقلل التنافر بينهم

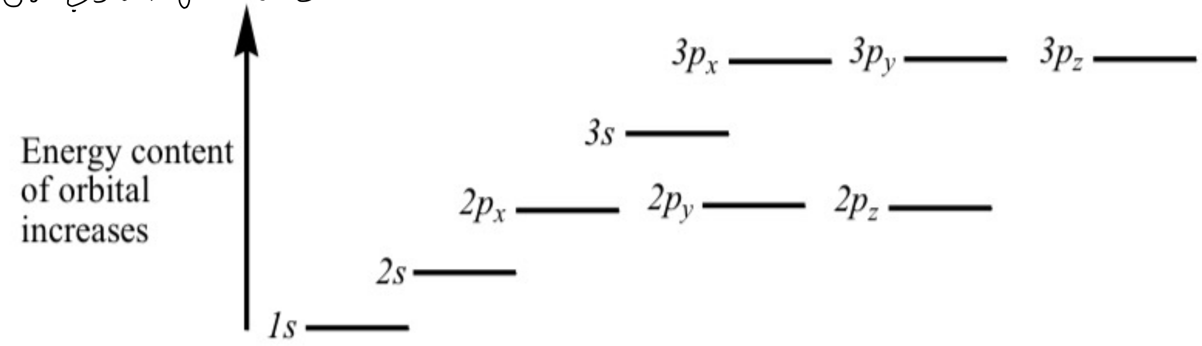


p_x orbital p_y orbital p_z orbital

Shapes of Organic Molecules: Orbital Picture of Covalent Bonds

Atomic Orbitals

- An energy level diagram of atomic orbitals. (شكل الـ e وهي بتدور
(الأشكال الناتجة من دوران e حول النواة)



- When filling the atomic orbitals, keep in mind that

  (1) An atomic orbital contain no more 2 electrons.

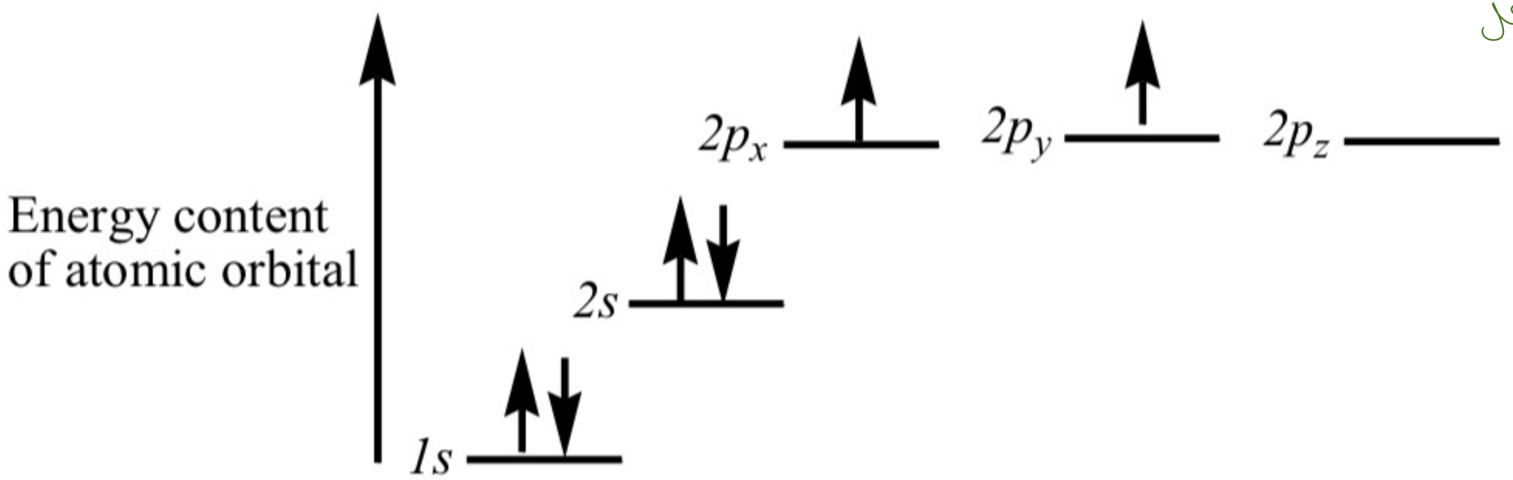
  (2) Electrons fill orbitals of lower energy first.

  (3) No orbital is filled by 2 electrons until all the orbitals of equal energy have at least one electron.

Atomic Orbitals

- The electronic configuration of carbon (atomic number 6) can be represented as

$$1s^2 2s^2 sp^1{}_x 2p^1{}_y \text{ or } 1s^2 2s^2 2p^2$$



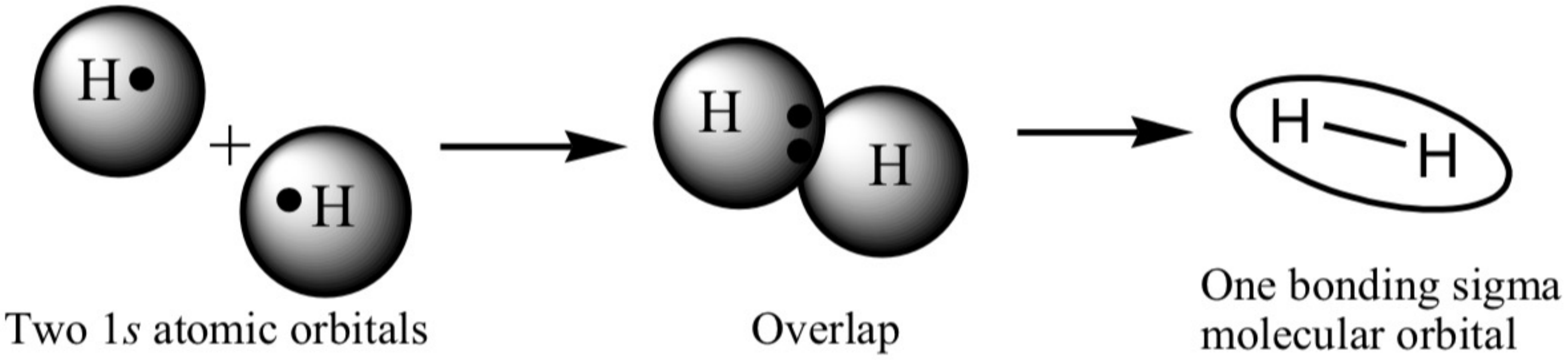
=> توزع e بشكل
منفرد =)

Energy level diagram for carbon.

Molecular Orbitals

- A covalent bond consists of the overlap between two atomic orbitals to form a molecular orbital.
- Example:

Molecular orbital of H_2



Shapes of Organic Molecules: Orbital Picture of Covalent Bonds

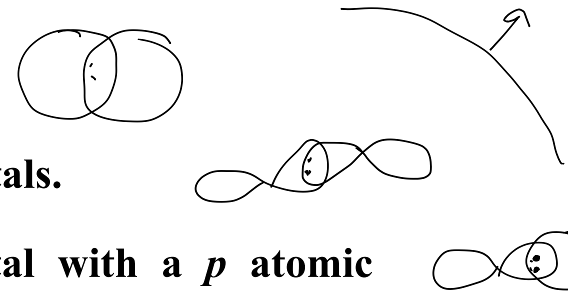
Molecular Orbitals

σ bond

- **Sigma bonds (□ bonds)** can be formed from

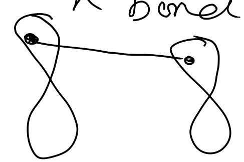
  التداخل

  - ➢ **The overlap of two *s* atomic orbitals.**
  - ➢ **The end-on overlap of two *p* atomic orbitals.**
  - ➢ **The overlap of two an *s* atomic orbital with a *p* atomic orbital.**



- **pi bonds (π bonds) can be formed from the side-side overlap between two *p* atomic orbitals.**

π bond



Bond Energy and Bond Length

(الجزيء اكثر استقرارا من الذرة المنفردة)

- **A molecule is more stable than the isolated constituent atoms.** (H_2 more stable than H)

  This stability is apparent in the release of energy during the formation of the molecular bond. ← الي بدل على ال stability هو انبعاث الطاقة اثناء تكون

- **Heat of formation (bond energy)** وهاي الطاقة إما

  The amount of energy released when a bond is formed.

- **Bond dissociation energy**

  The amount of energy that must be absorbed to break a bond.

- **Bond length**

  The distance between nuclei in the molecular structure.

لا لازم الأنوية تقترب قدر المستطاع حتى

e^- تدور بسهوله حول الرابطة والدماج orbitals ال

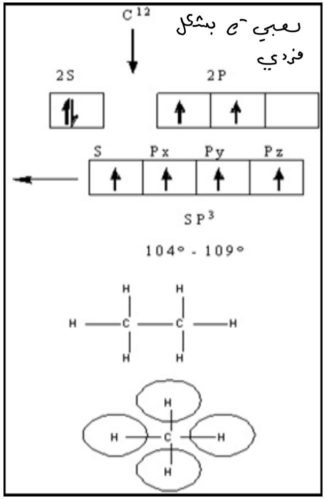
والى في مسافة معينة لأنو كلما اقترب اكثر كل

ازداد التنافر بين الشحنات الموجبة للأنوية

فال bond length هي المسافة المناسبة بين الأنوية لتكوين الرابطة

Hybridization (Alkanes *sp3*)

- In the case of **alkanes** ***sp3***, the three *2p* orbitals of the carbon atom are combined with its *2s* orbital to form four new orbitals called "***sp3***" hybrid orbitals.
- Four hybrid orbitals were required since there are four atoms attached to the central carbon atom.
- These new orbitals will have an energy slightly above the *2s* orbital and below the *2p* orbitals as shown in the following illustration.
- Notice that no change occurred with the *1s* orbital.

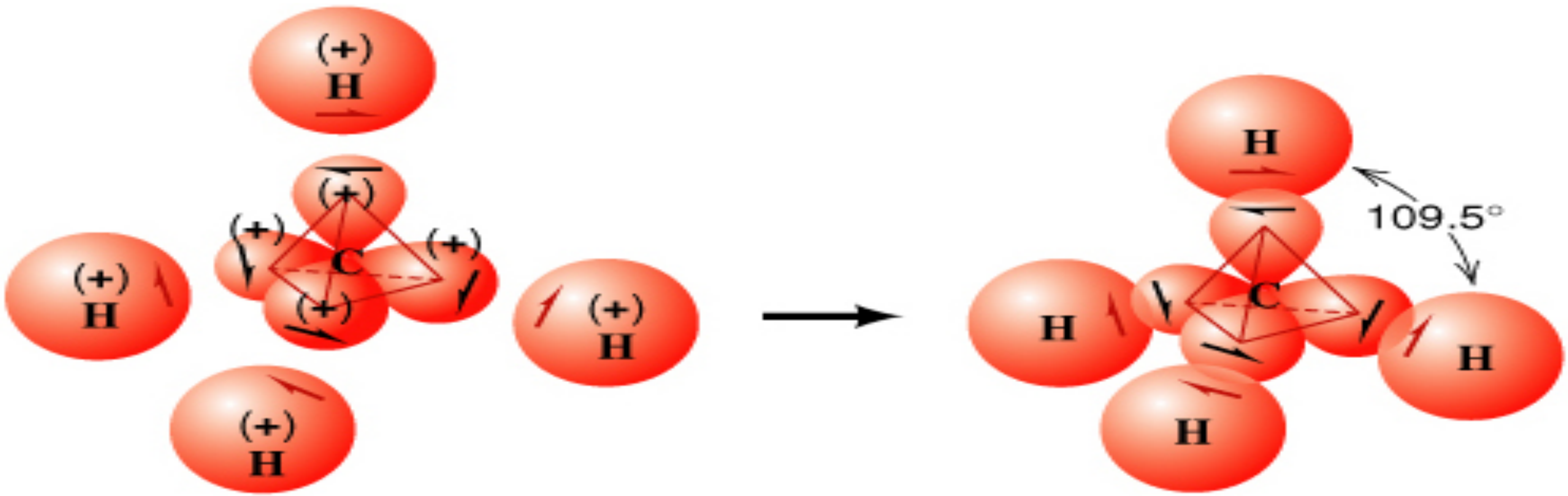


Methan e

- **Regular tetrahedron with all H-C-H bond angles of 109.5º.**

— sp_3 is a molecular orbital not an atomic orbital

Hybridization (Alkanes *sp3*)



Methane, CH_4

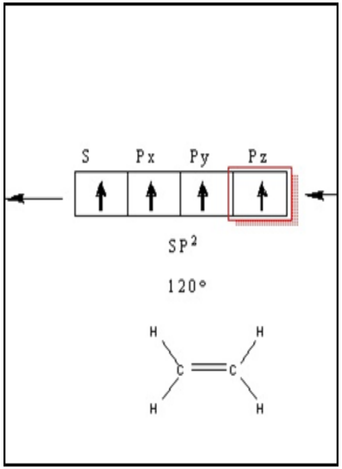
most stable structure

ل ابعد ما يكون بين ذرات ال H ← اقل تنافر بينهم

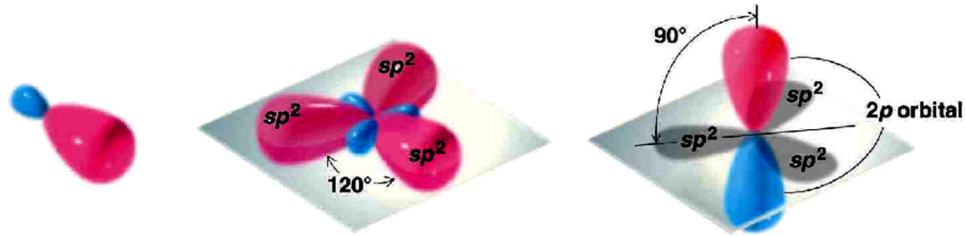
Hybridization (Alkenes sp2)

لما يكون في double bond

- In the case of **alkenes *sp2***, the *2s* orbital is combined with only two of the *2p* orbitals (*since we only need three hybrid orbitals for the three groups. thinking of groups as atoms and non-bonding pairs*) forming three hybrid orbitals called *sp2* hybrid orbitals.
- The other *p*-orbital remains unhybridized and is at right angles to the trigonal planar arrangement of the hybrid orbitals.
- **The trigonal planar** arrangement has **bond angles of 120°.**



Ethene *(Ethylene)*



(a) An sp^2 orbital (b) Three sp^2 orbitals (c) Three sp^2 orbitals and an unhybridized $2p$ orbital

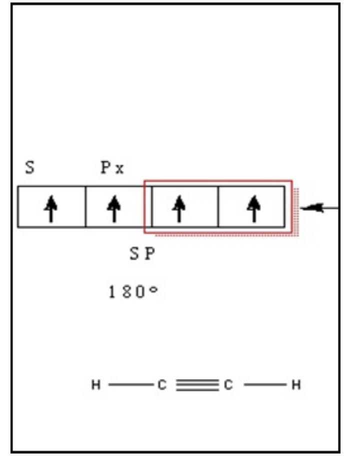
Hybridization (Alkynes *sp*)

trible bond

- In the case of **alkynes *sp***, the *2s* orbital is combined with only one of the *2p* orbitals to yield two *sp* hybrid orbitals.

- The two hybrid orbitals will be arranged as far apart as possible from each other with the result being a linear arrangement.

- The two unhybridized *p*-orbitals stay in their respective positions (at right angles to each other) and perpendicular to the **linear** molecule **(180□).**



Ethyne
(Acetylene)

Formal Charge

Formal Charge: **is the net charge on each atoms of the molecule or ion. (<u>which contain a covalent bond only</u>)**

How to calculate the Formal Charge (FC):

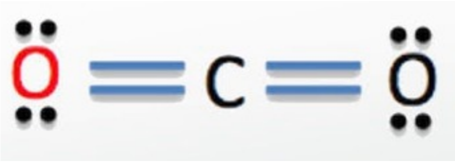
- يكون المركب
متعادل ولكن كل ذرة
بتكون عليها شحنة

$$FC = \begin{matrix}\text{Valence } e^- \\ \text{in Free Atom}\end{matrix} - \left(\begin{matrix}\text{Total} \\ \text{Nonbonding } e^-\end{matrix} + \frac{\begin{matrix}\text{Total} \\ \text{Bonding } e^-\end{matrix}}{2} \right)$$

Example: calculate the formal charge of CO2

FC for O= 6-(4+4/2)=0

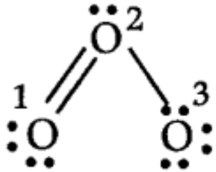
FC for C= 4-(0 + 8/2)= 0



Example :

Formal Charge

Lewis structure of O_3 is

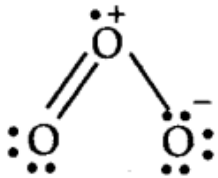


Formal charge on O(1) $= 6 - (4 + \frac{4}{2}) = 0$

Formal charge on O(2) $= 6 - (2 + \frac{6}{2}) = +1$

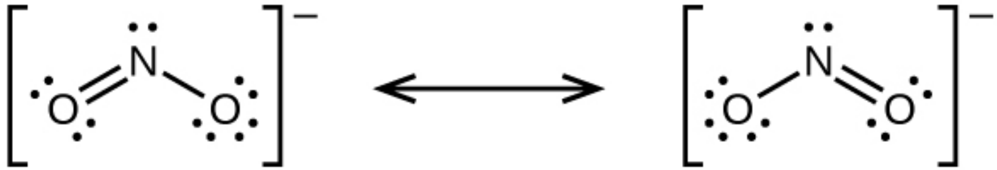
Formal charge on O(3) $= 6 - (6 + \frac{2}{2}) = -1$

Hence we represent O_3 along with formal charges as follows.



Formal Charge

Example:



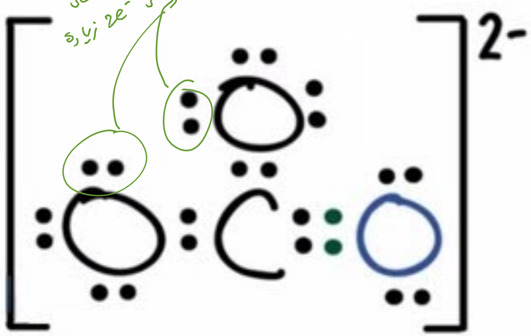
Formal charge: 0 0 –1 –1 0 0

Formal Charge

Example :

CO_3^{2-}

رأنو مرتبط مع 2H
عشان H_2CO_3
هيخزن $2e^-$ زيادة



كان المركب
H_2CO_3

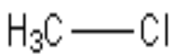
Formal Charge	=	Valence Electrons	-	NonBonding Val Electrons	-	Bonding Electrons / 2	=	
C	=	4	-	0	-	8/2	=	0
O	=	6	-	6	-	2/2	=	-1
O	=	6	-	4	-	4/2	=	0

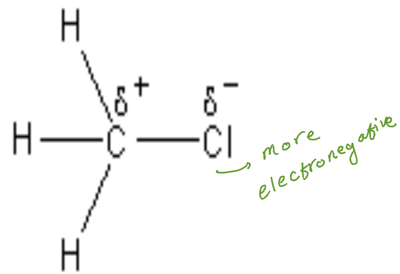
Inductive Effect

- **Inductive effect** **can be defined as** ***the permanent displacement of electrons forming a covalent bond (<u>sigma σ bonds</u>) towards the more electronegative element or group*.**
- **The inductive effect is represented by the symbol, the arrow pointing towards the more electronegative element or group of elements.**

(+ I) effect if the substituent electron-donating

(- I) effect i

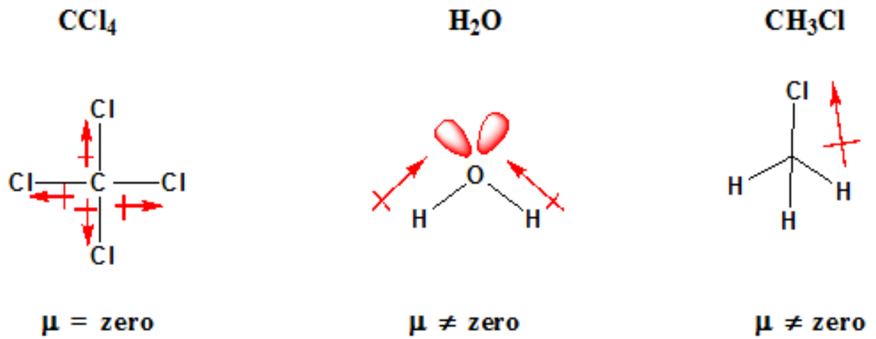




Electron-donating substituents (+I): -CH3, -C2H5,….
Electron-withdrawing substituents (-I): -NO2, -CN, -SO3H, COOH, COOR, NH2, OH, OCH3

Bond Polarity and Dipole Moment (μ)

- **Dipole moment** (depends on the inductive effect).
- A bond with the electrons shared equally between two atoms is called a **nonpolar bond** like in Cl-Cl and C-C bond in ethane.
- A bond with the electrons shared unequally between two different elements is called a **polar bond**.
- The **bond polarity** is measured by its dipole moment (μ).
- **Dipole moment (μ)** defined to be the amount of charge separation (+δ and –δ) multiplied by the bond length.

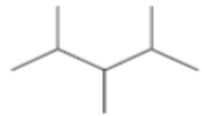


1.17: Classification According to Molecular Framework

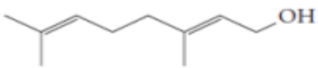
➢ The three main classes of molecular frameworks for organic structures are **acyclic**, **carbocyclic**, and **heterocyclic** compounds.

1.17.a Acyclic Compounds (*not cyclic*): contain chains that may be **unbranched** or **branched**.

unbranched chain of eight carbon atoms



branched chain of eight carbon atoms



geraniol
(oil of roses)
bp 229–230°C

$CH_3(CH_2)_5CH_3$

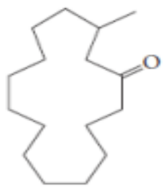
heptane
(petroleum)
bp 98.4°C

$CH_3\overset{\overset{O}{\|}}{C}(CH_2)_4CH_3$

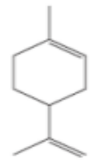
2-heptanone
(oil of cloves)
bp 151.5°C

1.17b: Carbocyclic Compounds: contain rings of carbon atoms

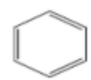
مركبات حلقية
تحتوي فقط على C



muscone
(musk deer)
bp 327–330°C



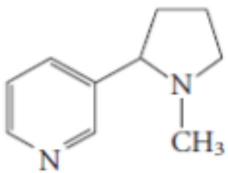
limonene
(citrus fruit oils)
bp 178°C



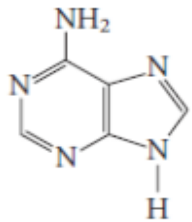
benzene
(petroleum)
mp 5.5°C, bp 80.1°C

1.17.c Heterocyclic Compounds (In heterocyclic compounds, at least one atom in the ring must be a heteroatom, an atom that is *not* carbon: *eg*. N, O,S...)

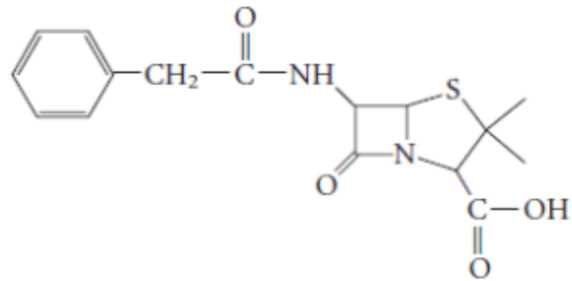
مركبات حلقية
تحتوي على ذرات غير الC



nicotine
bp 246°C



adenine
mp 360–365°C
(decomposes)

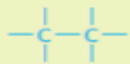
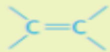
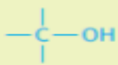


penicillin-G
(amorphous solid)

Classification According to Functional Group

A functional group is an arrangement of atoms with distinctive **physical** and **chemical** properties.

Table 1.6 The Main Functional Groups

	Structure	Class of compound	Specific example	Common name of the specific example
A. Functional groups that are a part of the molecular framework		alkane	$CH_3—CH_3$	ethane, a component of natural gas
		alkene	$CH_2=CH_2$	ethylene, used to make polyethylene
	$—C\equiv C—$	alkyne	$HC\equiv CH$	acetylene, used in welding
		arene		benzene, raw material for polystyrene and phenol
B. Functional groups containing oxygen				
1. With carbon–oxygen single bonds		alcohol	CH_3CH_2OH	ethyl alcohol, found in beer, wines, and liquors
		ether	$CH_3CH_2OCH_2CH_3$	diethyl ether, once a common anesthetic

إذا كانت المركبات بس
تحتوي على C فبصنفها
حسب الروابط

Table 1.6 continued

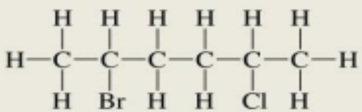
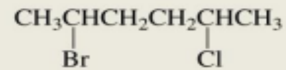
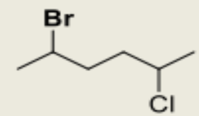
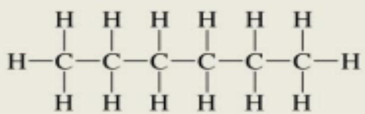
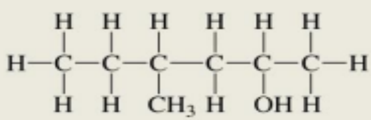
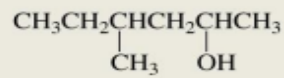
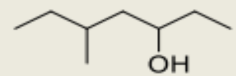
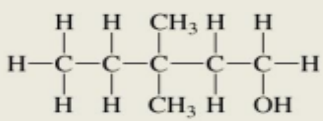
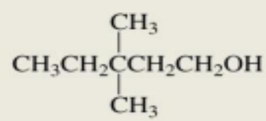
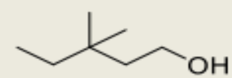
	Structure	Class of compound	Specific example	Common name of the specific example
*2. With carbon–oxygen double bonds**	$-\overset{\overset{O}{\|}}{C}-H$	aldehyde	$CH_2{=}O$	formaldehyde, used to preserve biological specimens
	$-\overset{\vert}{\underset{\vert}{C}}-\overset{\overset{O}{\|}}{C}-\overset{\vert}{\underset{\vert}{C}}-$	ketone	$CH_3\overset{\overset{O}{\|}}{C}CH_3$	acetone, a solvent for varnish and rubber cement
3. With single and double carbon–oxygen bonds	$-\overset{\overset{O}{\|}}{C}-OH$	carboxylic acid	$CH_3\overset{\overset{O}{\|}}{C}-OH$	acetic acid, a component of vinegar
	$-\overset{\overset{O}{\|}}{C}-O-\overset{\vert}{\underset{\vert}{C}}-$	ester	$CH_3\overset{\overset{O}{\|}}{C}-OCH_2CH_3$	ethyl acetate, a solvent for nail polish and model airplane glue
*C. Functional groups containing nitrogen***	$-\overset{\vert}{\underset{\vert}{C}}-NH_2$	primary amine	$CH_3CH_2NH_2$	ethylamine, smells like ammonia
	$-C{\equiv}N$	nitrile	$CH_2{=}CH-C{\equiv}N$	acrylonitrile, raw material for making Orlon
D. Functional group with oxygen and nitrogen	$-\overset{\overset{O}{\|}}{C}-NH_2$	primary amide	$H-\overset{\overset{O}{\|}}{C}-NH_2$	formamide, a softener for paper
E. Functional group with halogen	$-X$	alkyl or aryl halide	CH_3Cl	methyl chloride, refrigerant and local anesthetic
F. Functional groups containing sulfur†	$-\overset{\vert}{\underset{\vert}{C}}-SH$	thiol (also called mercaptan)	CH_3SH	methanethiol, has the odor of rotten cabbage
	$-\overset{\vert}{\underset{\vert}{C}}-S-\overset{\vert}{\underset{\vert}{C}}-$	thioether (also called sulfide)	$(CH_2{=}CHCH_2)_2S$	diallyl sulfide, has the odor of garlic

Functional Groups

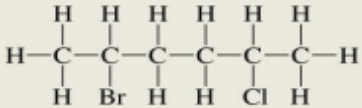
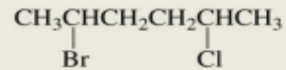
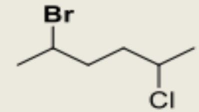
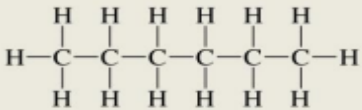
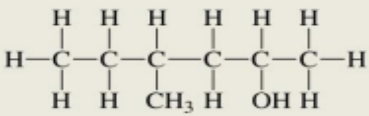
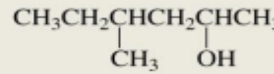
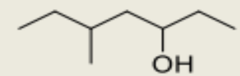
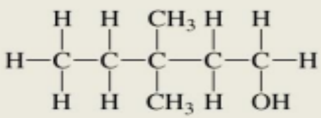
Functional Group is a reactive portion of an organic molecule, an atom, or a group of atoms that confers on the whole molecule its characteristic properties.

Class	General formula	Functional group	Specific
Alkane	RH	C – C (single bond)	H3C – CH3
Alkene	R – CH = CH2	C = C (double bond)	H2C = CH2
Alkyne		(triple bond)	
Alkyl halide	RX	-X (X = F, Cl, Br, I)	H3C - Cl
Alcohol	R – OH	-OH	H3C - OH
Ether	R – O –R'	- C- O – C -	H3C – O – CH3
Aldehyde			
Ketone			
Carboxylic acid			
Ester			
Amine	R – NH2		H3C – NH2

Dash formula

Kekul structur e	Condensed structures	Bond line formula
Atoms bonded to a carbon are shown to the right of the carbon. Atoms other than H can be shown hanging from the carbon.		
	$CH_3CHBrCH_2CH_2CHClCH_3$ or 	
Repeating CH_2 groups can be shown in parentheses.		
	$CH_3CH_2CH_2CH_2CH_2CH_3$ or $CH_3(CH_2)_4CH_3$	
Groups bonded to a carbon can be shown (in parentheses) to the right of the carbon, or hanging from the carbon.		
	$CH_3CH_2CH(CH_3)CH_2CH(OH)CH_3$ or 	
Groups bonded to the far-right carbon are not put in parentheses.		
	$CH_3CH_2C(CH_3)_2CH_2CH_2OH$ or 	

Dash formula

Kekul structur e	Condensed structures		Bond line formula
Atoms bonded to a carbon are shown to the right of the carbon. Atoms other than H can be shown hanging from the carbon.			
	$CH_3CHBrCH_2CH_2CHClCH_3$ or		
Repeating CH_2 groups can be shown in parentheses.			
	$CH_3CH_2CH_2CH_2CH_2CH_3$ or	$CH_3(CH_2)_4CH_3$	
Groups bonded to a carbon can be shown (in parentheses) to the right of the carbon, or hanging from the carbon.			
	$CH_3CH_2CH(CH_3)CH_2CH(OH)CH_3$ or		
Groups bonded to the far-right carbon are not put in parentheses.			
	$CH_3CH_2C(CH_3)_2CH_2CH_2OH$ or