وزارة التعليم العالي والبحث العلمي
الجامعة التقنية الشمالية
المعهد التقني الطبي/ كركوك

الحقيبة التعليمية

القسم العلمي: تقنيات الصيدلة

اسم المقرر: اساسيات الكيمياء العضوية

المرحلة / المستوى: الاولى

الفصل الدراسي:الاول

السنة الدراسية: 2024 - 2025

المعلومات العامة

اسم المقرر:	أساسيات الكيمياء العضوية						
القسم:	تقنيات الصيدلة						
الكلية:	المعهد التقني الطبي / كركوك						
المرحلة / المستوى	الاولى						
الفصل الدراسي:	الاول						
عدد الساعات الاسبوعية:	نظري	2	عملي	2			
عدد الوحدات الدراسية:	4						
الرمز:	PHT113						
نوع المادة	نظري		عملي		كليهما	✓	
هل يتوفر نظير للمقرر في الاقسام الاخرى	لا يوجد						
اسم المقرر النظير	-------						
القسم	--------						
رمز المقرر النظير	--------						

معلومات تدريسي المادة

اسم مدرس (مدرسي) المقرر:	بركل سليمان مصطفى
اللقب العلمي:	مدرس
سنة الحصول على اللقب	2015
الشهادة :	دكتوراه
سنة الحصول على الشهادة	2015
عدد سنوات الخبرة (تدريس)	27

الوصف العام للمقرر

تعرف الطالب على رسم المركبات العضوية وتسمياتها وانواع التفاعلات وميكانيكة التفاعل وطرق تحضيرها واستخدماتها في الصيدلة .

الاهداف العامة

- **سيتعلم الطلاب من فهم المفاهيم الأساسية في الكيمياء العضوية.**
- **سيتمكن الطلاب من تعلم البنية والخصائص الأساسية للمركبات العضوية.**
- **سيتعلم الطلاب من اكتساب مهارات تفسير الآليات الكيميائية والتفاعلات في المركبات العضوية.**

الأهداف الخاصة

- اكساب الطلاب رسم هيكل وخصائص المركبات العضوية الأساسية وكيفية تفاعلها.
- إلمام الطلاب بفهم الآليات الكيميائية والتفاعلات التي تحدث في المركبات العضوية مثل التفاعلات الإضافة، الاستبدال، التكافل، والتحولات الهيكلية.
- إلمام الطلاب بتطبيقات الكيمياء العضوية في الصيدلة .

الأهداف السلوكية او نواتج التعلم

- **أمثلة أهداف تدريسية:**

بعد الانتهاء من الدرس (المحاضرة) سيكون الطالب قادرا على ان:

- **تمييز وتحديد المركبات العضوية المختلفة بناءً على الهيكل الجزيئي والخصائص الفيزيائية والكيميائية .**
- **تحليل وفهم الآليات الكيميائية للتفاعلات التي تحدث في المركبات العضوية، مثل التفاعلات الإضافة، واستبدال الكتروفيلي والنيوكلوفي .**
- يقيم مستوى خطورة المواد الكيمياوية.

المتطلبات السابقة

- لايوجد

الأهداف السلوكية او مخرجات التعليم الأساسية		
ت	تفصيل الهدف السلوكي او مخرج التعليم	آلية التقييم
1	تعلم الطلاب الفهم العميق للمفاهيم الكيميائية الأساسية في مجال الكيمياء العضوية، مثل الهيكل الجزيئي، والروابط الكيميائية العضوية، والخواص الفيزيائية والكيميائية للمركبات العضوية.	اختبارات واستبيانات
2	تعزيز الفهم من خلال تجارب عملية تتضمن تحضير المركبات العضوية، وتحديد هياكلها باستخدام الأساليب التحليلية المختلفة.	مشاريع وتجارب عملية
3	القدرة على التعبير عن الأفكار الكيميائية بشكل واضح ومنطقي، سواء كان ذلك من خلال كتابة التقارير العلمية أو العروض التقديمية	المناقشات والمشاركة الفعالة
4	تعزيز مهارات الاستقلالية لدى الطلاب في تعلم المواد الكيميائية العضوية، مما يعزز قدرتهم على الاستمرار في التطور الأكاديمي والمهني.	التقييم الشامل والمستمر

أساليب التدريس

الاسلوب او الطريقة	مبررات الاختيار
1.ا لدروس التقليدية (المحاضرات)	• محاضرات تساعد في نقل المعرفة والمفاهيم الأساسية بشكل منظم ومنطقي، مما يسهل على الطلاب فهم النظريات والمفاهيم الكيميائية الأساسية • يتيح استخدام المحاضرات للطلاب فرصة لطرح الأسئلة والحصول على ردود فعل فورية من المدرس لتوضيح النقاط غير المفهومة بشكل صحيح. • يمكن للمحاضرات توضيح وشرح المفاهيم الكيميائية الصعبة بشكل أفضل من خلال استخدام الرسوم التوضيحية والمقاطع الفيديوية والنماذج الثلاثية الأبعاد.
2. استخدام البرمجيات والتطبيقات التفاعلية	• توفر البرمجيات والتطبيقات التفاعلية تجربة تعلم تفاعلية حقيقية، حيث يمكن للطلاب التفاعل مباشرة مع النماذج والمحاكاة الكيميائية لفهم الهيكل الجزيئي والآليات الكيميائية بشكل أفضل • تمكن البرمجيات والتطبيقات التفاعلية الطلاب من استكشاف الهيكل الجزيئي والآليات الكيميائية بأبعاد ثلاثية وبتفاصيل دقيقة، مما يسهل عليهم فهم العلاقات بين الذرات والروابط الكيميائية.
3. تعزيز مشاركة الطلاب في مشاريع البحث الصغيرة أو التقارير.	• يتيح مشروع البحث الفرصة للطلاب لتحسين مهارات التواصل العلمي، بما في ذلك كتابة التقارير وعرض النتائج، مما يعزز قدرتهم على التعبير بشكل دقيق وواضح عن أفكارهم ونتائج بحوثهم.
4. استخدام التقييم المستمر.	• يساعد التقييم المستمر على توجيه المدرسين في تحديد نقاط القوة والضعف لدى الطلاب بشكل دقيق. بالتالي، يمكن توجيه الإرشاد التعليمي بشكل مباشر لتلبية احتياجات الطلاب وتعزيز فهمهم. • يسمح التقييم المستمر بتحديد مستوى الإنجاز الفردي لكل طالب بشكل منتظم، مما يساعد في توجيه الطلاب وتقديم التعليم الدعم اللازم لتحقيق النجاح الأكاديمي. • يعتبر التقييم المستمر أداة أساسية لضمان جودة التعليم والتعلم، حيث يمكن للمدرسين والإدارات التعليمية تقييم فعالية البرامج التعليمية واتخاذ القرارات اللازمة لتحسينها. • يساعد التقييم المستمر في تحقيق اتساق في تقييم الطلاب وضمان عدالة العملية التعليمية، حيث يتم تطبيق المعايير نفسها على جميع الطلاب بشكل منتظم.
5. استخدام اسلوب مناقشات في عملية التعليم	• يوفر المناقشات للطلاب منصة لتحسين مهاراتهم في التواصل اللفظي والكتابي، حيث يتعلمون كيفية تعبير أفكارهم بشكل دقيق وواضح وكذلك الاستماع بفعالية لأفكار الآخرين. • شجع المناقشات الطلاب على المشاركة الفعالة والتفاعل مع المحتوى الدراسي، مما يعزز من تجربتهم التعليمية ويساهم في تحقيق أهداف التعلم بشكل أكثر نجاحًا.

الفصل الاول						
					الوقت	عنوان الفصل
طرق القياس	التقنيات	طريقة التدريس	العناوين الفرعية	العنوان الرئيسي	النظري	التوزيع الزمني
اختبارات قصيرة	عرض تقديمي، شرح، أسئلة وأجوبة, مناقشة	محاضرة	Importance of Organic chemistry Comparison of Organic and Inorganic Compounds	Introduction of organic chemistry	2 ساعة	الأسبوع الأول
			Ionic, Hydrogen, Covalent, Coordinate Bonds	Chemical bond ,Bonding in organic compounds,		
			Types of Hybridization :Methane (CH4) sp^3; Ethylene (C_2H_4) sp^2; Acetylene (C_2H_2) sp	Hybridization.		
توزيع استبيانات لقياس مدى استيعاب الطلاب للمفاهيم الرئيسية.	عرض تقديمي، شرح، أسئلة وأجوبة, مناقشة	محاضرة	Hund's Rule ; Pauli exclusion principle	Electron configurations	2 ساعة	الاسبوع الثاني
			Structural ; Stereoisomerism ; Tautomerism isomerism	Isomerism in organic compounds		
تقييم مستمر	عرض تقديمي، شرح، أسئلة وأجوبة, مناقشة	محاضرة	Types of hydrocarbons ; Hydrocarbyl (An alkyl) Common names of alkanes Physical properties of alkanes	Hydrocarbon saturated carbons (Alkane) Nomenclature ; physical properties	2 ساعة	الاسبوع الثالث
تكليف الطلاب بمشاريع صغيرة تتعلق بموضوع المحاضرة	عرض تقديمي، شرح، أسئلة وأجوبة, مناقشة	محاضرة	Hydrogenation of alkenes , Reduction of Haloalkanes , Grignard Reaction :	Structures ; chemical Properties Preparations methods ;		
			Cracking Alkanes; Combustion; Nitration; Chlorination; Halogenation using Sulphur Dichloride Dioxide Alkanes uses in pharmacy	Reactions , uses in pharmacy		

الفصل االثاني						
					الوقت	عنوان الفصل
طرق القياس	التقنيات	طريقة التدريس	العناوين الفرعية	العنوان الرئيسي	النظري	التوزيع الزمني
اختبارات قصيرة	عرض تقديمي، شرح، أسئلة وأجوبة, مناقشة	محاضرة	Naming alkenes ; Physical properties of alkenes: Structures of alkenes ; chemical properties of alkenes;	Hydrocarbon unsaturated, (Alkenes) Nomenclature; physical properties, Structures; chemical properties;	2 ساعة	الأسبوع الرابع
			Dehydrohalogenation of alkyl halides ; Dehydration of alcohols:	Preparation methods,		
			Addition of hydrogen; Addition of halogens; Addition of Sulphuric acid ; Polymerization; Addition of hydrogen halides; Combustion ; Oxidation; Alkenes uses in pharmacy	Reaction of carbon-carbon, uses in pharmacy.		
تكليف الطلاب بمشاريع صغيرة تتعلق بموضوع المحاضرة	عرض تقديمي، شرح، أسئلة وأجوبة, مناقشة	محاضرة	Structure and nomenclature Physical Properties; chemical properties of Cyclo Alkane	Cyclo alkane; Structures Nomenclature; physical & chemical properties.	2 ساعة	الاسبوع الخامس
			From dihalogen compounds; From alkenes; From aromatic compounds Free radical substitution; Addition reactions ; Oxidation	preparation methods ; Reaction of Cyclo alkane		
تقييم مستمر	عرض تقديمي، شرح، أسئلة وأجوبة,	محاضرة	Naming alkynes ; Physical properties of Alkynes Chemical Properties of Alkynes	Hydrocarbons (111) (Alkynes) Nomenclature; physical & chemical properties,	2 ساعة	الاسبوع السادس
			Dehydrohalogenation of alkyl halides ; Dehalogenation of Tetrahalides ; Reaction of Sodium acetylide with primary alkylhalides Addition of Hydrogen , Addition of halogen Addition of hydrogen halide	Preparation methods, Reaction of Alkynes		

الفصل الثالث						
عنوان الفصل	الوقت					
التوزيع الزمني	النظري	العنوان الرئيسي	العناوين الفرعية	طريقة التدريس	التقنيات	طرق القياس
الأسبوع السابع	2 ساعة	Aromatic hydrocarbons (Benzene); Nomenclature; physical & chemical properties	Nomenclature of aromatic hydrocarbons Physical Properties of Aromatic Compounds: Properties of Benzene	محاضرة	عرض تقديمي، شرح، أسئلة وأجوبة, مناقشة	اختبارات قصيرة
		Electrophilic aromatic substitution	Electrophilic aromatic substitution Nitration;Halogenation;Alkylation: Sulfonation			
الاسبوع الثامن	2 ساعة	Arenes (Structure, Nomenclature, physical & chemical properties.	Structure and nomenclature ; Physical and chemical properties of Arenes	محاضرة	عرض تقديمي، شرح، أسئلة وأجوبة, مناقشة	تكليف الطلاب بمشاريع صغيرة تتعلق بموضوع المحاضرة
		Chemical reaction; preparations methods	Attachment of alkyl group: Friedel-Crafts alkylation Hydrogenation. Oxidation; Substitution in the ring. Electrophilic aromatic substitution; Halogenation of alkylbenzenes: ring vs. side chain.			
الاسبوع التاسع	2 ساعة	Organic halogen compound (Alky / halide) Structure;	Organic halogen compound; Applications; Alkyl halides; Classified of Alkyl halides; Primary alkyl halides ; Secondary alkyl halides; Tertiary alkyl halides	محاضرة	عرض تقديمي، شرح، أسئلة وأجوبة,	تقييم مستمر
		Nomenclature; physical & chemical properties.	Nomenclature:Physical properties of Alkyl halide			

الفصل الرابع						
عنوان الفصل	الوقت					
التوزيع الزمني	النظري	العنوان الرئيسي	العناوين الفرعية	طريقة التدريس	التقنيات	طرق القياس
الأسبوع العاشر	2 ساعة	Preparation of Alkyl halide	Halogenation ; Addition of hydrogen halide to alkenes and alkynes: Addition of hydrogen halide to alcohol	محاضرة	عرض تقديمي، شرح، أسئلة وأجوبة, مناقشة	اختبارات قصيرة
		Reactions. (Nucleophilic substitution) uses pharmacy	Nucleophilic substitution ; Elimination reaction: Preparation of Grignard reagents; Reduction Alkyl halide uses in pharmacy			
الاسبوع الحادي عشر	2 ساعة	Alcohol; structure and nomenclature , Physical properties	Classification of Alcohols; Aprimary alcohols; Secondary alcohols; Tertiaary alcohols; Nomenclature; Physical properties of alcohols	محاضرة	عرض تقديمي، شرح، أسئلة وأجوبة, مناقشة	تكليف الطلاب بمشاريع صغيرة تتعلق بموضوع المحاضرة
		Preparation of Alcohol	Hydration of Alkenes; Hydroboration			
الاسبوع الثاني العشر	2 ساعة	Reaction of Alcohol	Reactions with hydrogen halides; Dehydration	محاضرة	عرض تقديمي، شرح، أسئلة وأجوبة,	تقييم مستمر
		uses in pharmacy	Alcohol uses in pharmacy			

الفصل الخامس						
عنوان الفصل	الوقت					
التوزيع الزمني	النظري	العنوان الرئيسي	العناوين الفرعية	طريقة التدريس	التقنيات	طرق القياس
الأسبوع الثالث العشر	2 ساعة	Phenol; structure and nomenclature ; Physical properties	Nomenclature ; Classification of Phenols : Monohydroxy phenols Dihydroxyl phenols Physical properties of phenols	محاضرة	عرض تقديمي، شرح، أسئلة وأجوبة, مناقشة	اختبارات قصيرة
الاسبوع الرابع العشر	2 ساعة	Preparation of Phenol	Addition of sodium hydroxide to Chlorobenzene ; Cumene ; Benzene; Ethers	محاضرة	عرض تقديمي، شرح، أسئلة وأجوبة, مناقشة	اختبارات قصيرة
		Reaction of Phenol	Electrophilic substitution reactions Halogenation ; Nitration; Sulfonation: Hydrogenation			
الاسبوع الخامس العشر	2 ساعة	Phenol uses in pharmacy	Phenol uses in pharmacy	محاضرة	عرض تقديمي، شرح، أسئلة وأجوبة,	اختبارات قصيرة

المحتوى العلمي

رقم المحاضرة: الاولى	
عنوان المحاضرة:	Introduction to Organic Chemistry , Chemical bonds ,Bonding in organic compounds ,Hybridization
اســـــم المدرس:	د. بركل سليمان مصطفى
الفئة المستهدفة :	المستوى الاول
الهدف العام من المحاضرة :	اكتساب المفاهيم الأساسية المتعلقة بتركيب وخصائص الجزيئات العضوية والروابط الكيميائية الحيوية والتهجين
الأهداف السلوكية او مخرجات التعلم:	1- التعرف على أنواع الروابط الكيميائية الأساسية مثل الروابط التساهمية، والروابط الأيونية، والروابط التساهمية المتعددة 2-القدرة على شرح كيفية تأثير نوع الروابط الكيميائية على الخصائص الفيزيائية والكيميائية للمركبات العضوية 3- التعرف على مفهوم التهجين وأنواعه مثل sp^3 و sp^2 و sp ، وكيفية تأثيره على تشكيل الأوربيتالات الجزيئية في المركبات العضوية
استراتيجيات التيسير المستخدمة	1- استخدام نماذج جزيئية ثلاثية الأبعاد لتوضيح هياكل الجزيئات العضوية والروابط الكيميائية. يمكن للطلاب رؤية الجزيئات بشكل ملموس وتفاعل معها لفهم كيفية ترابط الذرات والهيكل الجزيئي بشكل أفضل. 2- الاستفادة من التطبيقات التفاعلية والبرمجيات التعليمية التي تسهل فهم المفاهيم الكيميائية المعقدة مثل الهيكل الجزيئي والتهجين. يمكن استخدام محاكاة الكيمياء العضوية لتوضيح الظواهر الكيميائية بطريقة تفاعلية ومباشرة
المهارات المكتسبة	1- القدرة على تحليل أنواع الروابط الكيميائية الأساسية مثل الروابط التساهمية، والروابط الأيونية، والروابط التساهمية المتعددة، وفهم كيفية تأثيرها على الخصائص الكيميائية للمركبات العضوية. 2- القدرة على تحليل وفهم أنواع التهجين المختلفة مثل sp^3 و sp^2 و sp ، وكيفية أثيرها على هيكل الجزيئات العضوية وخواصها الكيميائية، واستخدام هذا التهجين في شرح الظواهر الكيميائية.
طرق القياس المعتمدة	استخدام اختبارات كتابية تتضمن أسئلة متنوعة مثل الأسئلة الاختيارية، والأسئلة الكتابية القصيرة، والأسئلة العملية التي تتطلب من الطلاب تطبيق المفاهيم على حل مشكلات كيميائية

الاسئلة القبلية

Q1: Define the following terms :

Organic chemistry, Electronegativity, hybridization

Q2: Choose the correct answer for the following sentences:

1- The type of Bonding is covalent when the difference in electronegativity between two atoms are ----------.

A- (0 - 0.6) B- (0.7-1.6) C- (1.7 - 4)

2- Organic compounds are held together by---------- bonds.

A-Ionic B-Coordinate C- Covalent

Q3: Answer True or False of the following sentences:

1- Most organic compounds are flammable, while most inorganic compounds are nonflammable.

2- Inorganic compounds generally a complex structure contain many atoms, while organic compounds usually a simpler structure contain relatively few atoms.

3- Hydrogen bonding can be considered a special case of dipole - dipole bonding between the hydrogen atom of one group and another electronegative group.

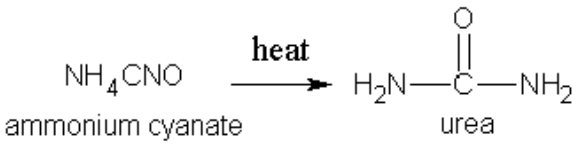
Q4: Fill in the blanks to complete the meaning of the following sentences:

1- The ------- is defined as the concept of mixing two atomic orbitals with the same energy levels to give a degenerated new type of orbital.

2- The resulting bond is also an electron pair or covalent bond; but because both electrons are furnished by the nitrogen, called a --------- covalent bond.

Introduction to Organic Chemistry

In the eighteenth century it was believed that a "vital force" was needed to make the compounds produced by living cells. These compounds were said to be organic compounds. However, this belief was overthrown by a German chemist, Fredrick Wohler, in 1828. He prepared urea, a compound generally found in the blood and urine, by heating a solution of ammonium cyanate, an inorganic compound.



Importance of Organic Chemistry

Organic chemistry is important in that it is the chemistry associated with all living matter in both plants and animals. Carbohydrates, fats, proteins, vitamins, hormones, enzymes, and many drugs are organic compounds. Wool, silk, cotton, linen, and such synthetic fibers as nylon, rayon, and Dacron contain organic compounds. So do perfumes, dyes, flavors, soaps, detergents, plastics, gasoline, and oils.

Definition of organic chemistry

Organic chemistry is a branch of chemistry that studies the structure, properties, and reactions of organic compounds and materials that contains the element carbon atom in covalent bonding to other atoms.

Comparison of Organic and Inorganic Compounds

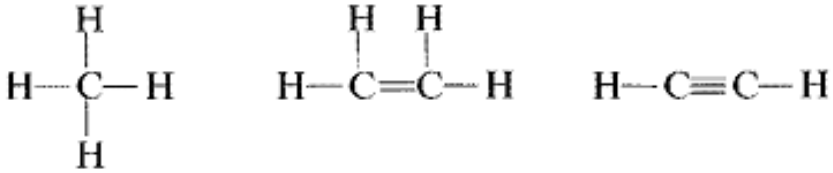
Organic compounds differ from inorganic compounds in many ways. The most important of these are listed below.

1. Most organic compounds are flammable, while most inorganic compounds are nonflammable.

2. Most organic compounds have low melting, boiling points, while most inorganic compounds have high melting , boiling points.
3. Most organic compounds are insoluble in water, while many inorganic compounds are soluble in water.
4. Organic compounds are held together by covalent bonds, while many inorganic compounds contain ionic bonds.
5. Organic reactions usually take place between molecules, while Inorganic reactions usually take place between ions.
6. Organic compounds generally a complex structure contain many atoms, while Inorganic compounds usually a simpler structure contain relatively few atoms.

Bonding in organic compounds;

Organic compounds-compounds of carbon-are held together by covalent bonds. Recall that covalent bonds are formed by sharing electrons. In organic chemistry, the term bond is used to designate a shared pair of electrons. Thus, the statement is made that carbon forms four bonds; it has an oxidation number of -4. Bonds are usually represented by a short, straight line connecting the atoms. Each carbon atom in the following compounds forms four bonds.



four single bonds to carbon | double bond between carbons | triple bond between carbons

Chemical bonds

Ionic Bonds:

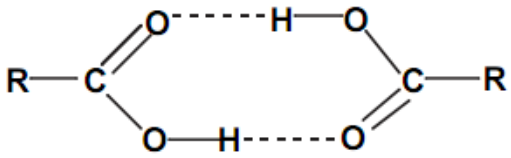
These arise from the electrostatic force which exists between two groups of opposite charge.

$$Na^{+} + Cl^{-} \longrightarrow [Na^{+}][Cl^{-}]\ Sodium\ chloride$$

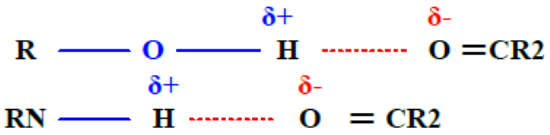
$$Ca^{+2} + 2H^{-} \longrightarrow [Ca^{+2}][\ H^{-}]_2\ Calcium\ hydride$$

Hydrogen Bonds

Hydrogen bonding can be considered a special case of dipole - dipole bonding between the hydrogen atom of one group and another electronegative group.



----- hydrogen bond



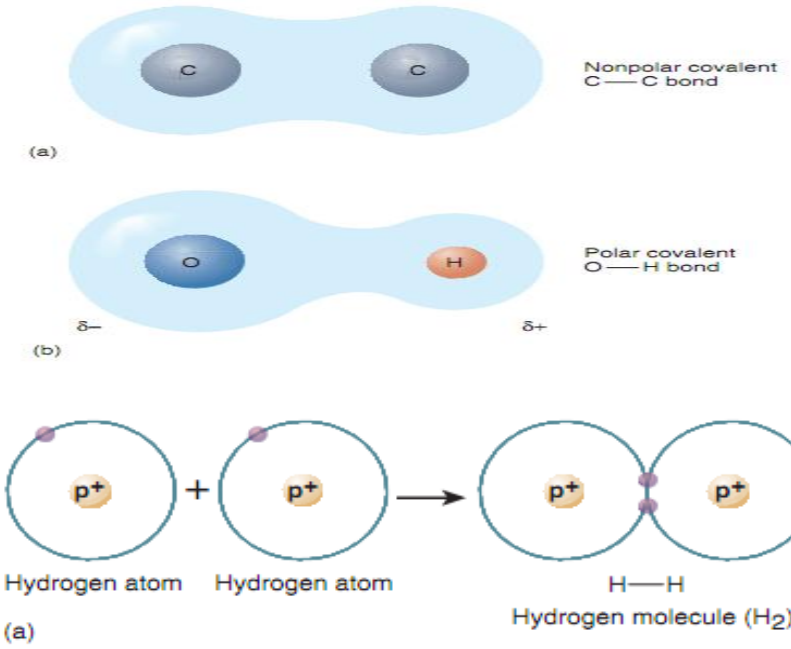
Covalent Bond

In these, electrons are shared between atoms, and this bond is much more powerful than the other types discussed above. Drugs which combine covalently are very persistent in their action.

Electronegativity (χ): of an atom **in a molecule** is a measure of the ability of the atom to attract **electrons bonds to** itself.

Covalent bonds, formed by sharing of electrons between the two atoms, may be of two types: **non-polar** and **polar.**

- **Non-polar covalent bonds**: A covalent bond formed by two atoms having equal electro negativity.
- **Polar covalent bonds**: A covalent bond formed by two atoms having unequal electronegativity. The electrons pair is shared unequally by the two atoms with the result the atoms have some partial charges.



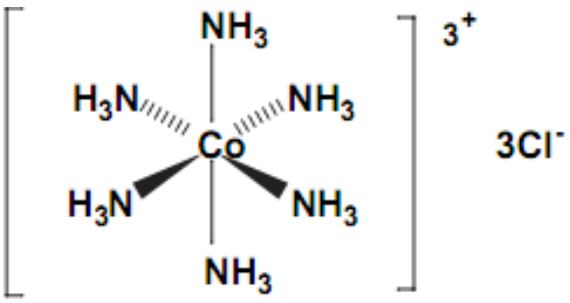
How to Predict Bonding Type Using Electronegativity

The difference in electronegativity between two atoms of organic compound

0 - 0.6	the bond is covalent bonds
o.7 - 1.6	the bond is polar covalent bonds
1.7 - 4	the bond is ionic bond

Coordinate Bonds

The resulting bond is also an electron pair or covalent bond; but because both electrons are furnished by the nitrogen, the bond is sometimes called acoordinate covalent bond.



Hybridization

Hybridization is defined as the concept of mixing two atomic orbitals with the same energy levels to give a degenerated new type of orbital. This intermixing is based on quantum mechanics. The atomic orbitals of the same energy level can only take part in hybridization and both full-filled and half-filled orbitals can also take part in this process, provided they have equal energy.

During the process of hybridization, the atomic orbitals of similar energy are mixed such as the mixing of two 's' orbitals or two 'p' orbitals or mixing of an 's' orbital with a 'p' orbital or 's' orbital with a 'd' orbital.

Types of Hybridization

Based on the types of orbitals involved in mixing, the hybridization can be classified as sp^3, sp^2, sp, Let us now discuss the various types of hybridization, along with their examples.

Methane (CH_4) sp^3 Hybridization

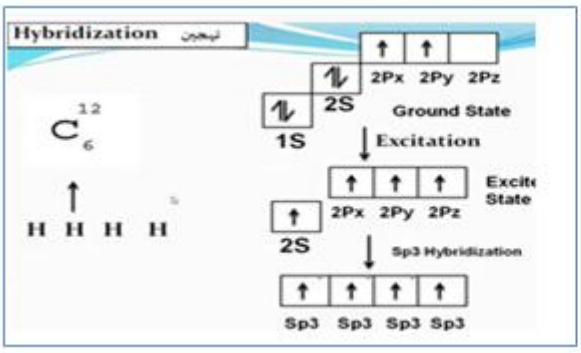
When one 's' orbital and 3 'p' orbitals belonging to the same shell of an atom mix together to form four new equivalent orbitals, the type of hybridization is called a tetrahedral hybridization or sp^3 The new orbitals formed are called sp^3 hybrid orbitals.

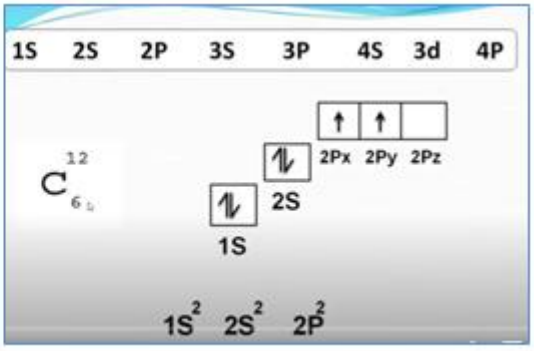
Methane (CH_4) Hybridization

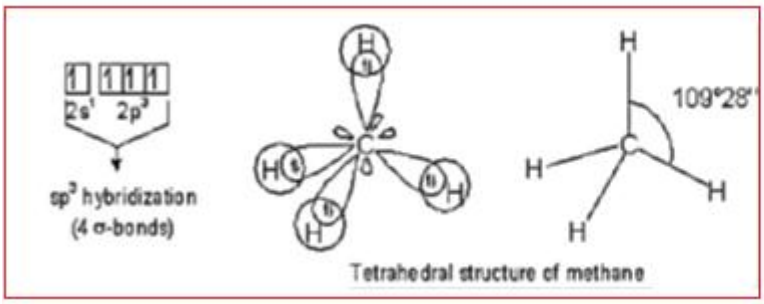
First and foremost, it is important to note that carbon has the electron configuration of $1s^2\ 2s^2\ 2p^2$. This means that carbon would have 2 unpaired electrons in its p orbitals. Theoretically, this means that carbon will only form 2 bonds, but that is not the case.

As seen in methane (CH_4), carbon can form 4 bonds. The rationale behind this phenomenon is hybridization. Supporting evidence shows that 1 s and 3p orbitals are being combined to form hybrid orbitals, allowing the polyatomic

molecule to have 25% s character and 75% p character. Thus, we call methane a sp^3-hybridized molecule.







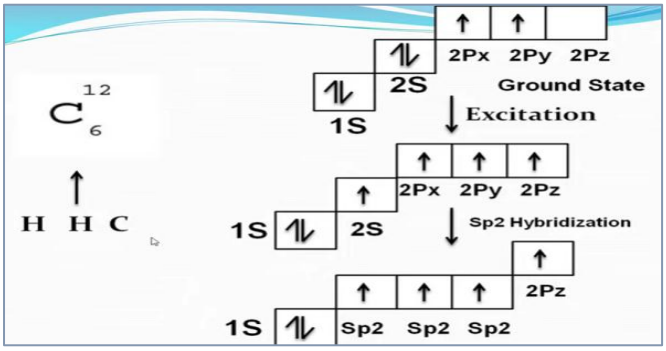
Sp3

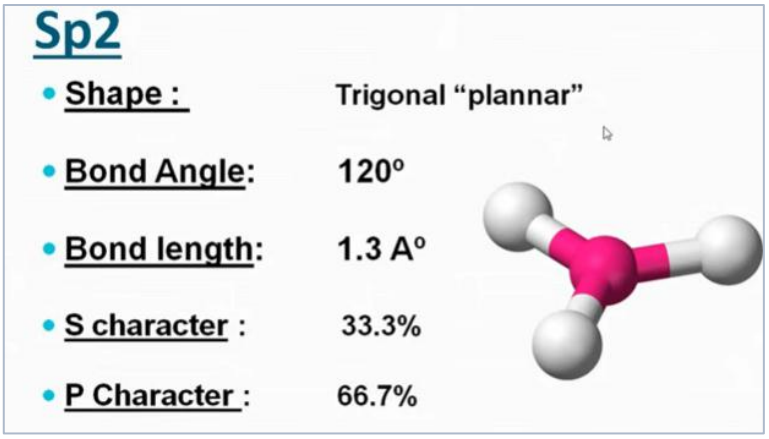
- **Shape :** Tetrahedral "Pyrimidal"
- **Bond Angle:** 109.5°
- **Bond length:** 1.5 A°
- **S character :** 25%
- **P Character :** 75%

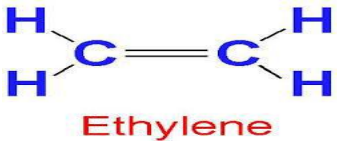
Ethylene (C_2H_4) sp^2 Hybridization

Let us look at how the hybridization of ethene (ethylene) occurs. When we look at the molecules of C_2H_4 it has 2 C atom and 4 H atom. The carbon atom consists of 6 electrons and hydrogen has 1 electron.

During the formation of $CH_2=CH_2$, the electronic configuration of carbon in its ground state ($1s^2\ 2s^2\ 2px^1\ 2py^1\ 2pz^0$) will change to an excited state and change to $1s^2\ 2s^1\ 2px^1 2py^1\ 2pz^1$. In the excited state, since carbon needs electrons to form bonds one of the electrons from the $2s^2$ orbital will be shifted to the empty 2pz orbital to give 4 unpaired electrons.



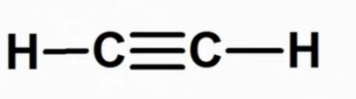




Ethylene

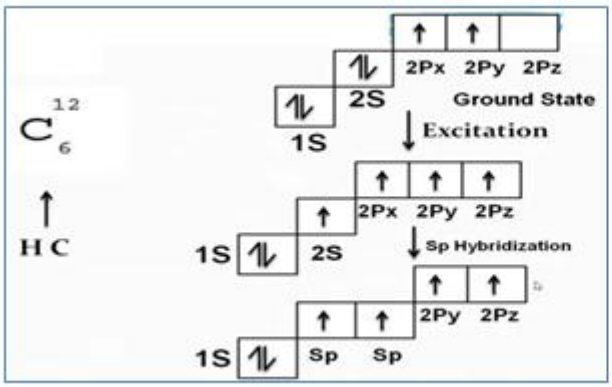
Acetylene (C_2H_2) sp Hybridization

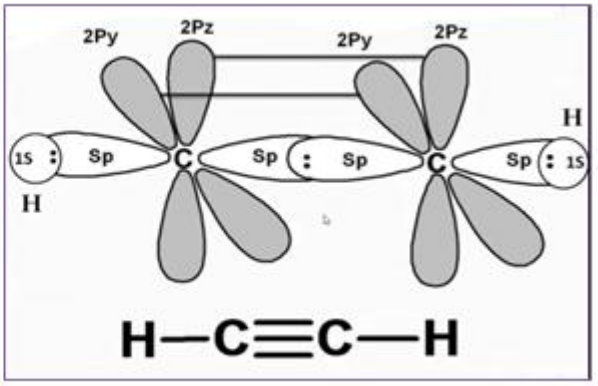
The hybrid orbital concept applies well to triple-bonded groups, such as alkynes. Consider, for example, the structure of ethyne (another common name is acetylene), the simplest alkyne.



Ethyne
"Acetylene"

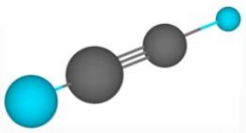
This molecule is linear: all four atoms lie in a straight line. In the hybrid orbital picture of acetylene, both carbons are **sp-hybridized**. In an **sp**-hybridized carbon, the **2s** orbital combines with the **2px** orbital to form two **sp** hybrid orbitals that had oriented at an angle of 180°. The **2py** and **2pz** orbitals remain non-hybridized.





Sp

- **Shape :** Linear
- **Bond Angle:** 180°
- **Bond length:** 1.2 A°
- **S character :** 50%
- **P Character :** 50%



Questions after the lecture

الأسئلة البعدية

Q1: Choose the correct answer for the following sentences.

1- Hybridization in methane is sp^3 shape Orbitals is ----------.

A- Tetrahedral B- Tigonal plannar C- linear

2- The----- bonding can be considered a special case of dipole - dipole bonding between the hydrogen atom of one group and another electronegative group

A- Ionic B- Hydrogen C- Covalent

Q2: Fill in the blanks to complete the meaning of the following sentences:

1- The ---- bond formed by two atoms having equal electro negativity.

2- The hybridization can be classified as--------, ---------, ---------- .

3- Hybridization in methane is sp^2 shape Orbitals is ----------.

4- Hybridization in methane is -------, shape Orbitals is Tetrahedral.

Q3: Answer True or False of the following sentences:

1- Most organic compounds have low melting, boiling points. While inorganic compounds have high melting, boiling points.

2- The type of bonding is polar covalent when the difference in electronegativity between two atoms are (0.7 - 1.6).

3-Organic reactions usually take place between molecules, while Inorganic reactions usually take place between ions.

Q4: Enumerate the types of hybridization and explain sp briefly.

Q5: Enumerate the difference between Organic and Inorganic Compounds.

رقم المحاضرة: الثانية	
عنوان المحاضرة:	Electron configuration; chemical formulas isomerism.
اســـــم المدرس:	د. بركل سليمان مصطفى
الفئة المستهدفة :	المستوى الاول
الهدف العام من المحاضرة :	تعرف على كيفية توزيع الإلكترونات حول الذرات في الطبقات الإلكترونية والأربيتالات ,تحديد كيفية تأثير تكوين الإلكترونات على الخواص الكيميائية للعناصر والأيونات واشكال وايزومرات.
الأهداف السلوكية او مخرجات التعلم:	1- التعرف على كيفية ترتيب الإلكترونات حول الذرات وفهم تأثير هذا التكوين على الخواص الكيميائية للعناصر. 2-القدرة على استخدام الجدول الدوري لتحديد توزيع الإلكترونات والذرات. 3- التعرف على أنواع الايزومرية المختلفة مثل الايزومرات الهيكلية، الضوئية، والتناظري
استراتيجيات التيسير المستخدمة	1- استخدام نماذج جزيئية واقعية أو تفاعلية لعرض تكوين الإلكترونات والهياكل الجزيئية للمركبات. 2 -استخدام رسوم بيانية ملونة ورسوم متحركة لشرح العلاقات الكيميائية والهياكل الجزيئية. 3- توفير موارد رقمية مثل مقاطع الفيديو القصيرة أو الرسوم المتحركة التي توضح عمليات تكوين الإلكترونات والصيغ الكيميائية بطريقة بديهية وملموسة.
المهارات المكتسبة	1- تعلم الطلاب كيفية ترتيب الإلكترونات حول الذرات في المستويات الإلكترونية والأربيتالات المختلفة. 2-اكتساب القدرة على كتابة الصيغ الكيميائية بدقة للمركبات المختلفة، بما في ذلك الأيونات والمركبات العضوية وغير العضوية. 3- تطوير المعرفة بأنواع الايزومرية المختلفة مثل الايزومرات الهيكلية، الضوئية، والتناظرية.
طرق القياس المعتمدة	استخدام اختبارات كتابية تتضمن أسئلة متنوعة مثل الأسئلة الاختيارية، والأسئلة الكتابية القصيرة، والأسئلة العملية التي تتطلب من الطلاب تطبيق المفاهيم على حل مشكلات كيميائية

الاسئلة القبلية

Q1: Define the following terms :

Hund's Rule, Pauli Exclusion principle

Q2: Choose the correct answer for the following sentences:

1- Pauli exclusion principle states no ----- electrons in an atom can have the same 4 quantum numbers.

A- 1 B- 2 C- 3

2-Compounds having the same number and kind of atoms but having different bonding arrangements between the atoms are called---------- isomers.

A- Position B- Functional **C**- Geometric

Q3: Answer True or False of the following sentences:

1- The distribution of electrons among the orbitals of an atom is called the electron configuration.

2- Compounds having the same number and kind of atoms but having different bonding arrangements between the atoms are called Position isomers.

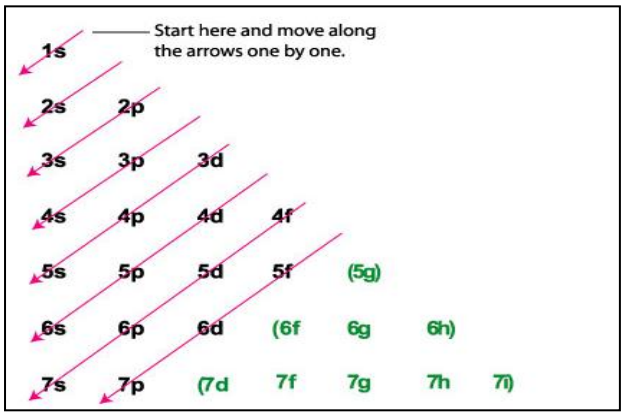
Electron Configurations of atoms:

The distribution of electrons among the orbitals of an atom is called **the electron configuration**. The electrons are filled in according to a scheme known as the **Aufbau principle** ("building-up"), which corresponds (for the most part) to **the increasing** energy of the subshells:

· no two electrons in the atom will share the same four quantum numbers (n, ℓ, ml, and ms).

Principal Quantum Number (n) ; Secondary quantum number (ℓ); Magnetic Quantum Number (ml) ; Spin Quantum Number (ms)

· electrons will first occupy orbitals of the **lowest** energy level.
· electrons will fill an orbital with the **same spin** number until the orbital is Flled before it will begin to fill with the **opposite** spin number.



Fig(3): Filling order of principal levels and sublevels

s	↑↓					
p	↑↓	↑↓	↑↓			
d	↑↓	↑↓	↑↓	↑↓	↑↓	
f	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓

$1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$, $3d^{10}$, $4p^6$, $5s^2$, $4d^{10}$, $5p^6$, $6s^2$, $4f^{14}$, $5d^{10}$, $6p^6$, $7s^2$, $5f^{14}$

When electrons are placed in a set of orbitals of equal energy, they are spread

Out as much as possible to give as few paired electrons as possible (**Hund's rule**).

Hund's Rule states when filling orbitals the orbitals of the same energy put one electron in each orbital until all orbitals are half filled then go back and pair them.
Pauli Exclusion Principle - no **2** electrons in an atom can have the same **4** quantum numbers.

Examples :

- $1s^2\ \ 2s^2\ 2p^5$ means "**2** electrons in the **1s** subshell, **2** electrons in the **2s** subshell, and **5** electrons in the **2p** subshell".
- $1s^2\ \ 2s^2 2p^6\ \ 3s^2\ 3p^3$ is an electron configurations with **15** electrons total ; **2 electrons** have **n=1** (in the **1s** subshell); **8 electrons** have **n**=**2** (**2e** in the **2s** subshell and **6e** in **2p** subshell); and **5** electrons have **n**=**3** (2e in the **3s** subshell and **3e** in 3p subshell).

The elements are stable when subshell orbitals are **empty or half-filled or filled.**

Write the electron configurations **for the** elements:

$_3Li$: $1s^2\ 2s^1$; $_3Li^+$: $1s^2$

$_6C$: $1s^2\ \ 2s^2\ 2p^2$; $_6C^-$: $1s^2\ \ 2s^2\ 2p^3$; $_6C^+$: $1s^2\ \ 2s^2 2p^1$

$_{12}Mg$: $1s^2\ \ 2s^2\ 2p^6\ \ 3s^2$

$_{13}Al$: $1s^2\ \ 2s^2 2p^6\ \ 3s^2\ 3p^1$

$_{20}Ca$: $1s^2\ 2s^2\ \ 2p^6\ \ 3s^2\ 3p^6\ 4s^2$

$_{24}Cr$: $1s^2\ 2s^2\ \ 2p^6\ \ 3s^2\ 3p^6\ 4s^2\ 3d^4 \longrightarrow 1s^2\ 2s^2\ \ 2p^6\ \ 3s^2\ 3p^6\ 4s^1\ 3d^5$

$_{24}Cr^{+2}$: $1s^2\ 2s^2\ \ 2p^6\ \ 3s^2\ 3p^6\ \ 3d^4$

$_{26}Fe$: $1s^2\ 2s^2\ \ 2p^6\ \ 3s^2\ 3p^6\ 4s^2\ 3d^6$; $_{26}Fe^{+2}$: $1s^2\ 2s^2\ \ 2p^6\ \ 3s^2\ 3p^6\ \ 3d^6$

$_{29}Cu$: $1s^2\ 2s^2\ \ 2p^6\ \ 3s^2\ 3p^6\ 4s^2\ 3d^9 \longrightarrow 1s^2\ 2s^2\ \ 2p^6\ \ 3s^2\ 3p^6\ 4s^1\ 3d^{10}$

$_{29}Cu^{+2}$: $1s^2\ 2s^2\ \ 2p^6\ \ 3s^2\ 3p^6\ 3d^9$

$_{10}Ne$: $1s^2\ 2s^2\ \ 2p^6$

$_{18}Ar$: $_{10}[Ne]\ 3s^2\ 3p^6$; $_{36}Kr$: $_{18}[Ar]\ 3d^{10}\ 4s^2 4p^6$

Chemical formulas

Chemical formulas are representations of chemical compounds using symbols for elements and numbers indicating the ratio of atoms in the compound. They provide concise and standardized ways to describe the composition of substances in chemistry. Here are some key points about chemical formulas:

1. **Element Symbols:** Chemical formulas use symbols to represent elements. For example, "H" for hydrogen, "O" for oxygen, "Na" for sodium, etc.
2. **Subscript Numbers:** These numbers are used to indicate the number of atoms of each element in a molecule or formula unit. For example, H_2O represents water, where there are two hydrogen atoms and one oxygen atom.
3. **Empirical Formula:** Shows the simplest whole number ratio of elements in a compound. For example, the empirical formula for hydrogen peroxide is H_2O_2.
4. **Molecular Formula:** Indicates the actual number of atoms of each element in a molecule. For example, the molecular formula for hydrogen peroxide is H_2O_2, indicating two hydrogen atoms and two oxygen atoms per molecule.
5. **Structural Formula:** Shows the arrangement of atoms within the molecule, typically indicating the connectivity between atoms using lines and the number of bonds.
6. **Ionic Compounds:** Involves the use of positive and negative ions held together by electrostatic forces, such as in table salt (NaCl).

Chemical formulas are fundamental in chemistry as they convey essential information about the composition and structure of substances, aiding in understanding their properties and behavior in chemical reactions

Isomerism in organic compounds

Isomerism refers to the phenomenon where compounds with the same molecular formula have different arrangements of atoms, leading to different chemical and sometimes physical properties. There are several types of isomerism:

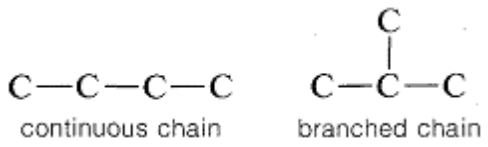
1- Structural isomerism

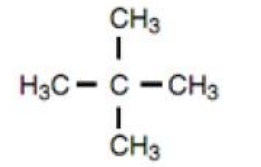
2- Stereoisomerism

3- Tautomerism

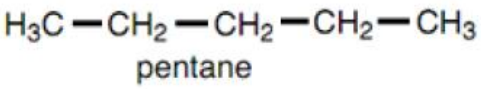
Structural isomerism

More than one stable substance can correspond to a given molecular formula. Examples are butane and 2- methylpropane (isobutane), each of which has the molecular formula C_4H_{10} . Similarly, methoxymethane (dimethyl ether) and ethanol have the same formula, C_2H_6O :

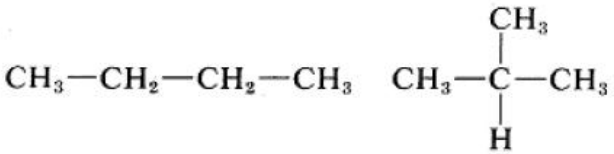




2,2-dimethyl-propane



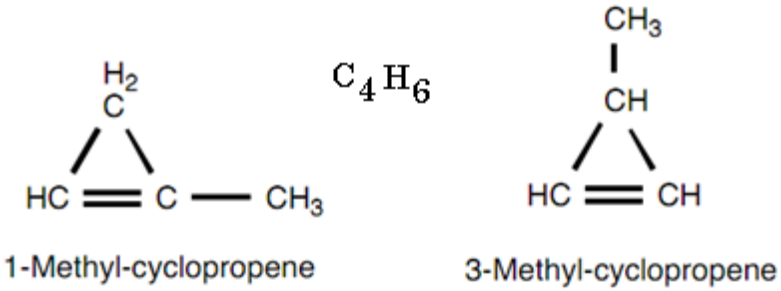
pentane

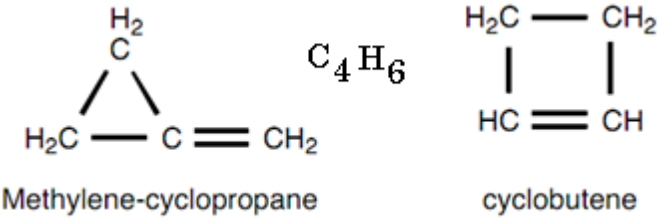


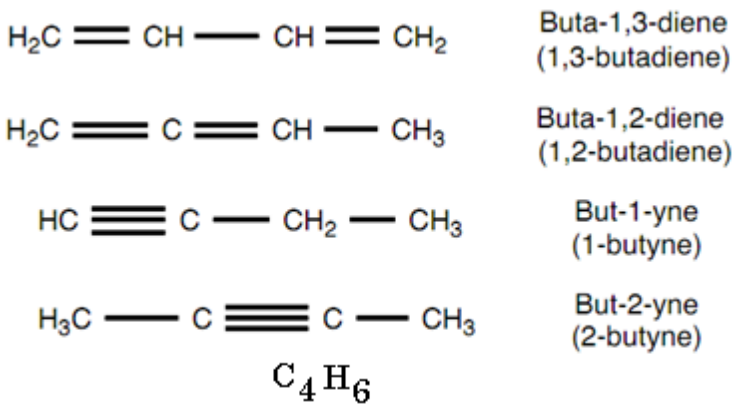
butane C_4H_{10} 2-methylpropane

1-Position Isomers

Compounds having the same number and kind of atoms but having different bonding arrangements between the atoms are called position isomers



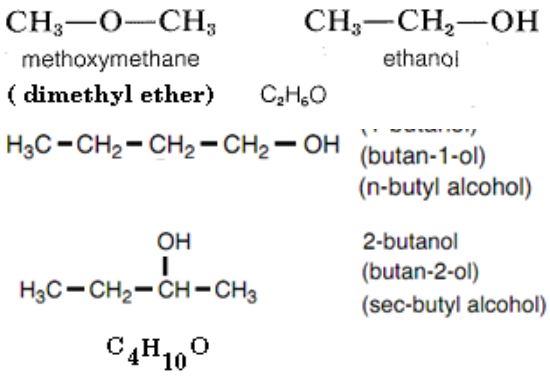




These molecules are structurally different, accordingly, do not have the same chemical and physical properties. They cannot be converted one into the other without breaking and remaking C-C and C-H bonds.

2-Functional isomerism

Methoxymethane and ethanol are also position isomers because the oxygen clearly is connected differently in the two molecules:



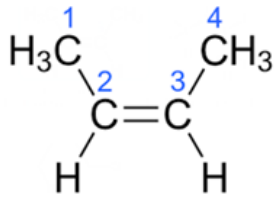
2- **Stereoisomerism:** Isomers with the same connectivity of atoms but differ in

The spatial arrangement of atoms or groups. This can be further divided into:

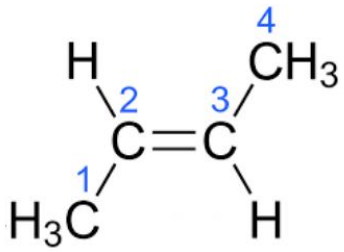
A- Geometric (Cis-trans) Isomerism: Occurs due to restricted rotation around a double bond or ring structure, resulting in different spatial arrangements.

Examples:

- **Cis-2-butene:** In cis-2-butene, the two methyl groups ($-CH_3$) are on the same side of the double bond.



- **Trans-2-butene:** In trans-2-butene, the two methyl groups are on opposite sides of the double bond.

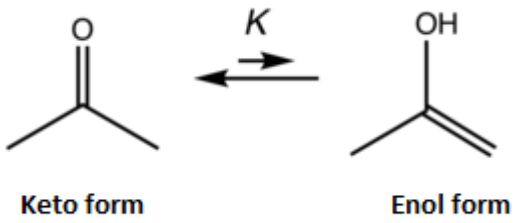


B- Optical Isomerism: Arises from the presence of chiral centers, where molecules are non-superimposable mirror images (enantiomers) or have different spatial arrangements (diastereomers).

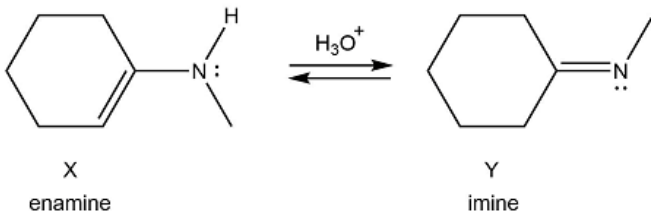
3-Tautomerism: Involves isomers that rapidly interconvert through the migration of a hydrogen atom and a double bond. This results in different functional groups or bonding patterns.

Types of Tautomers:

A- Keto-Enol Tautomerism: This is the most common type where a keto tautomer (containing a carbonyl group, C=O) and an enol tautomer (containing an alcohol group, C-OH) interconvert. The equilibrium favors the keto form due to the stability of the carbonyl group.



B- Amino-Imine Tautomerism: Involves the reversible migration of a hydrogen atom between an amino group (NH_2) and an imine group (C=N).



Questions after the lecture

الأسئلة البعدية

Q1: Choose the correct answer for the following sentences.

1-The ------- formula indicates the actual number of atoms of each element in a molecule.

A- Molecular **B-** Structural **C-** Empirical

2-The ------- formula shows the arrangement of atoms within the molecule, typically indicating the connectivity between atoms using lines and the number of bonds.

A- Molecular B- Structural C- Empirical

3-Ethoxymethane and ethanol are examples of---------- isomers.

A. Geometric isomers B. Optical isomers C. Functional isomers

4-Cis-trans isomerism is a type of ----------isomerism.

A. Optical B. Position C. Geometric

5- The type of isomerism arises from the presence of chiral centers is ---------.

A. Geometric isomerism B. Optical isomerism C. Position isomerism

Q2: Answer True or False of the following sentences:

1- Keto-Enol Tautomerismt this type where a keto tautomer contains a carbonyl group and an enol tautomer containing an alcohol group.

2- Geometric (Cis-trans) Isomerism occurs due to restricted rotation around a double bond or ring structure, resulting in different spatial arrangements

3- Compounds having the same number and kind of atoms but having different bonding arrangements between the atoms are called position isomers.

4- Position isomers have the same chemical and physical properties because they differ only in the spatial arrangement of atoms.

5- Cis-trans isomerism occurs due to unrestricted rotation around a double bond or ring structure.

Q**3: Enumerate the types of Isomers and give example of them.**

رقم المحاضرة: الثالثة	
عنوان المحاضرة:	Hydrocarbon (1) saturated carbons (Alkane)Nomenclature ; physical properties ; Structures ; chemical properties ;Preparations methods ; reactions , uses in pharmacy
اســـــم المدرس:	د. بركل سليمان مصطفى
الفئة المستهدفة :	المستوى الاول
الهدف العام من المحاضرة :	تعرف على الهيدروكاربونات والكانات وكيفية تسميتها وفقا لقواعد النظام الدولي وطرق تحضيرها واستخداماتها في الصيدلة .
الأهداف السلوكية او مخرجات التعلم:	1- التعرف على بنية الألكانات وتفاعلات الألكانات وأنواع الروابط الكيميائية داخل الجزيئات . 2- التعرف على طرق تحضير الألكانات بمختلف الطرق الكيميائية مثل عمليات لهيدروجينة والهالوجينة والتكاثف . 3- التعرف على فهم تطبيقات الألكانات في الصناعات المختلفة بما في ذلك الصيدلة والصناعة الكيميائية.
استراتيجيات التيسير المستخدمة	1- استخدام الرسوم التوضيحية والرسوم البيانية لعرض الهيكل الجزيئي للألكانات والعلاقات بين الكربونات والهيدروجينات فيها. هذا يساعد على تفسير البنية والخصائص الفيزيائية والكيميائية بطريقة بصرية وسهلة الفهم. 2-استخدام المواقع والمصادر التعليمية على الإنترنت التي توفر شروحات متقدمة وأمثلة واقعية عن استخدامات الألكانات في الصيدلة والصناعة. 3-تشجيع النقاشات وتكوين المجموعات الصغيرة حول موضوع الألكانات، حيث يمكن للطلاب مناقشة الأفكار وتبادل المعرفة والخبرات، مما يعزز الفهم ويسهم في تطبيق المعلومات النظرية على سياقات واقعية.
المهارات المكتسبة	1- اكتساب القدرة على تسمية الألكانات بشكل صحيح باستخدام النظام الدولي للتسمية، مما يعزز الفهم الدقيق لتركيب وتسمية الألكانات بمختلف الأطوال الكربونية. 2-اكتساب القدرة على فهم كيفية تفاعل الألكانات مع مجموعة متنوعة من المواد الكيميائية مثل المؤكسدات، والحموض، والقواعد، والهاليدات، وتحديد التأثيرات التي قد تنشأ نتيجة لهذه التفاعلات. 3- فهم التفاعلات الكيميائية المختلفة التي يمكن أن تحدث مع الألكانات وكيفية تطبيق هذه التفاعلات في مجال الصيدلة، مثل استخدام الألكانات كمواد أساسية أو وسيطة في صناعة الأدوية.
طرق القياس المعتمدة	استخدام اختبارات كتابية تتضمن أسئلة متنوعة مثل الأسئلة الاختيارية، والأسئلة الكتابية القصيرة، والأسئلة العملية التي تتطلب من الطلاب تطبيق المفاهيم على حل مشكلات كيميائية

الاسئلة القبلية

Q1: Define the following terms :

Hydrocarbons, Hydrocarbyl , Alkanes

Q2: Choose the correct answer for the following sentences:

1- Organic compounds consisting entirely of --------- and hydrogen
A- Oxygen B- Carbon C- Sodium

2- The characterizes---------- hydrocarbons composed entirely of single bonds and are saturated with hydrogen

A- Saturated B-Un saturated C- cycloalkanes

3-The compound which containing one or more carbon rings are called ---------- Hydrocarbons.

A- Saturated B-Un saturated C- cycloalkanes

4- Each carbon atom in an alkane can form -----bonds.

A- Four B- One C- Two

5- Which type of hydrocarbon is also known as arenes ------ .

A. Aromatic hydrocarbons B. Cycloalkanes C. Saturated hydrocarbons

Q3: Answer True or False of the following sentences:

1- Alkanes are unsaturated hydrocarbons.

2- The general chemical formula for alkanes is CnH2n+2.

3- Alkanes can contain double or triple bonds between carbon atoms.

4- Alkanes belong to a homologous series where each member differs by a molecular mass of 14.03.

5- Alkanes are highly reactive compared to unsaturated hydrocarbons.

Hydrocarbons

In organic chemistry, a hydrocarbon is an organic compound consisting entirely of hydrogen and carbon.

Types of hydrocarbons

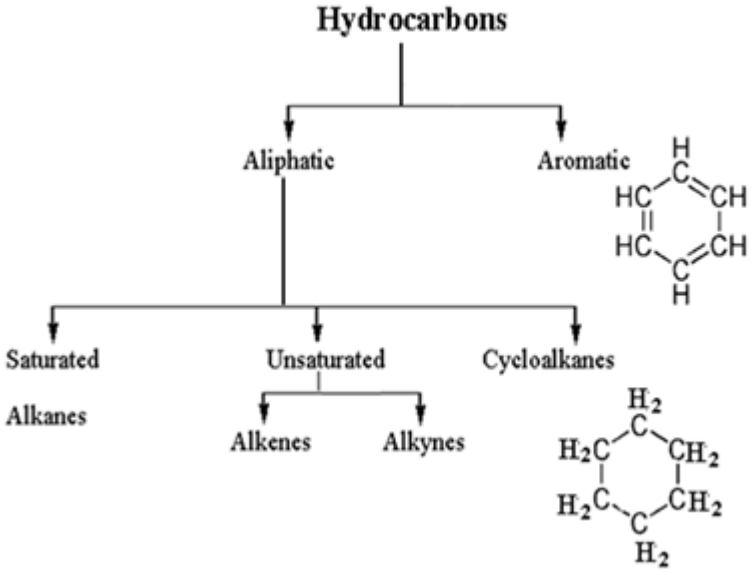
The classifications for hydrocarbons defined by structure ,IUPAC (International **U**nion of **P**ure and **A**pplied **C**hemistry) nomenclature of organic chemistry and physical and chemical properties are as follows:

1-**Saturated hydrocarbons** are the simplest of the hydrocarbon species and are composed entirely of single bonds and are saturated with hydrogen.

2- **Unsaturated hydrocarbons** have one or more double or triple bonds between carbon atoms.

3- **Cycloalkanes** are hydrocarbons containing one or more carbon rings to which hydrogen atoms are attached.

4- **Aromatic Hydrocarbons**, also known as arenes, are hydrocarbons that have at least one aromatic ring.



Scheme1: classifications for hydrocarbons

Hydrocarbons from which one hydrogen atom has been removed are functional groups, called **hydrocarbyls**.

Hydrocarbyl (An alkyl)

In organic chemistry, an **alkyl** group is an alkane missing one hydrogen with the general formula C_nH_{2n+1}, where **n** is some integer. For example, a methyl group (CH_3) is a fragment of a methane molecule (CH_4); n = 1 in this case. "The **-yl** ending means a fragment of an alkane formed by removing a hydrogen". In structural formula, the symbol **R** is used to designate a generic alkyl group.

Number of carbon aton..	ane (single bond)	Alkene (double bond)	Alkyne (triple bond)	Alkyl
1	Methane	-	-	Methyl
2	Ethane	Ethene (ethylene)	Ethyne (acetylene)	Ethyl
3	Propane	Propene (propylene)	Propyne (methylacetylene)	*n*-Propyl
4	Butane	Butene (butylene)	Butyne	*n*-Butyl
5	Pentane	Pentene	Pentyne	*n*-Pentyl
6	Hexane	Hexene	Hexyne	*n*-Hexyl
7	Heptane	Heptene	**Heptyne**	*n*-Heptyl
8	Octane	Octene	Octyne	*n*-Octyl
9	Nonane	Nonene	Nonyne	*n*-Nonyl
10	Decane	Decene	Decyne	*n*-Decyl

Table 1: Simple hydrocarbons and their variations

Alkanes

In organic chemistry, an **alkane**, or **paraffin**, is a saturated hydrocarbon. Alkanes consist only of hydrogen and carbon atoms and all bonds are single bonds. Alkanes (always acyclic or open-chain compounds) have **the general chemical formula C_nH_{2n+2}**. For example, methane is CH_4, in which n=1 (n being the number of carbon atoms).

Alkanes belong to a homologous series of organic compounds in which the members differ by a molecular mass of 14.03 (mass of a methanediyl group, —CH_2—, one carbon atom of mass 12.01, and two hydrogen atoms of mass ≈1.01 each). Each carbon atom has 4 bonds (either C-H or C-C bonds), and each hydrogen atom is joined to a carbon atom (H-C bonds). They are normally very stable compounds and relatively un-reactive in comparison with their unsaturated counterparts.

Number of 'C' atoms	IUPAC name	Structure	Molecular formula
1	Methane	CH_4	CH_4
2	Ethane	$CH_3—CH_3$	C_2H_6
3	Propane	$CH_3—CH_2—CH_3$	C_3H_8
4	Butane	$CH_3—(CH_2)_2—CH_3$	C_4H_{10}
5	Pentane	$CH_3—(CH_2)_3—CH_3$	C_5H_{12}
6	Hexane	$CH_3—(CH_2)_4—CH_3$	C_6H_{14}
7	Heptane	$CH_3—(CH_2)_5—CH_3$	C_7H_{16}
8	Octane	$CH_3—(CH_2)_6—CH_3$	C_8H_{18}
9	Nonane	$CH_3—(CH_2)_7—CH_3$	C_9H_{20}
10	Decane	$CH_3—(CH_2)_8—CH_3$	$C_{10}H_{22}$

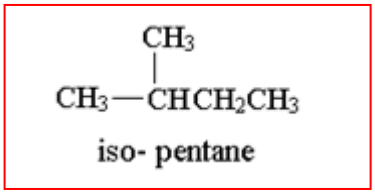
Table 2: Name and structure of hydrocarbons

Common names of alkanes

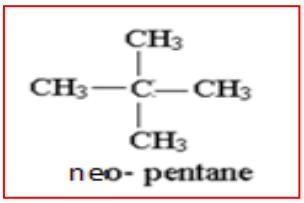
- The prefix **n-** , has been retained for any alkanes in which all carbons form a continuous chain with no branching :

$CH_3CH_2CH_2CH_2CH_3$	$CH_3(CH_2)_4CH_3$
n-Pentane	**n-Hexane**

❖ The prefix iso- , is used when a compound has a single carbon branch on the carbon adjacent to the last carbon on the chain.



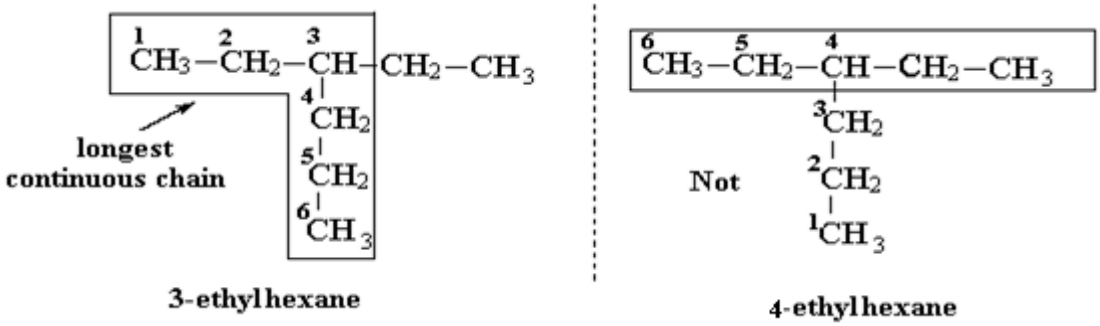
❖ The prefix neo- , has been retained for any alkanes in which carbon attached by four alkyl groups.



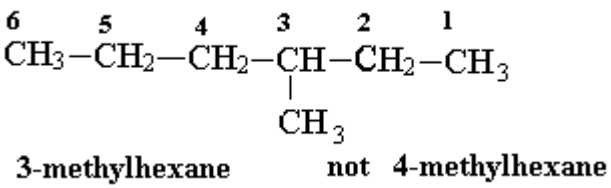
The IUPAC System of nomenclature :

IUPAC: International Union of Pure and Applied Chemistry

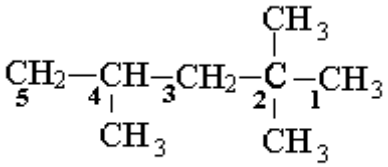
1-Select at the parent structure the longest continuous chain and consider the compound have been derived from this structure by the replacement of hydrogens by various alkyl substituents .



2- In numbering the parent carbon chain ,start from whichever end will give the lowest number for the side of attachment of the substituent .

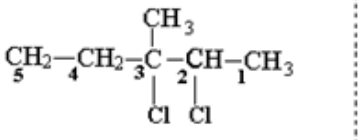


3- If the same alkyl substituent occurs more than once on the parent carbon chain , the prefixes di-, tri- , tetra- , penta- ,etc.. are used to indicate whether are two, three ,four ,or five substituents . The position of these substituents on the parent carbon chain are indicated by various number separated by commas. If substituents occurs twice on the same carbon, the number is repeated.



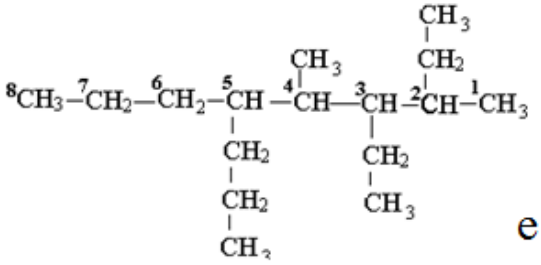
2 , 2 , 4 - trimethylpentane

If there are several different alkyl groups attached to the parent chain, name them in alphabetical order .



2 ,3 - dichloro- 3- methylpentane

c , m



2,3- diethyl -4- methyl -5- propyloctane

e , m , p

Physical properties of alkanes

1- All alkanes are colourless & possess no characteristic odour.

2-The straight – chain alkanes, C_1 to C_4 are gases, C_5 to C_{17} are liquids , and the remaining higher homologous are all solids at $20^{O}C$.

2- Boiling points and melting points increase with increasing molecular weight.

3- The density of alkane's increases with increasing molecular weight, and the branching contributes to reducing this factor.

4- Alkanes being non polar and thus insoluble in water but soluble in non-polar solvents e.g., C_6H_6, CCI_4, ether etc. The solubility of alkanes decreases with increase in molecular weight. Liquid alkanes are non-polar solvents

Chemical Properties of alkane:

Alkanes are inert compounds towards many acids and bases, and they are not affected by oxidizing agents such as potassium permanganate and reducing agents such as lithium aluminum hydride ($LiAlH_4$). The reason for this resistance is due to the non-polarity of the bonds in alkanes and the fact that they do not contain atoms that possess free electron pairs such as oxygen or nitrogen.

The characteristic of resistance is these have made them widely used and good solvents. The non-polarity of the bonds (C-C) leads to their breaking in a homogeneous manner when they gain enough activation energy to break them. Therefore, these compounds react when heated to high temperatures. They also react with oxygen, chlorine, and bromine as well, or in the presence of light. These reactions include Homogeneous fission of the bond and the formation of free radicals at high temperatures.

Preparation of alkanes

1-Hydrogenation of alkenes :

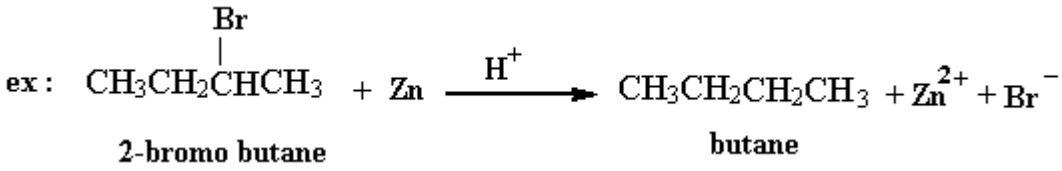
$$\underset{\text{Alkene}}{C_nH_{2n}} + H_2 \xrightarrow[\text{Or Ni}]{\text{Pt}} \underset{\text{Alkane}}{C_nH_{2n+2}}$$

ex : $\underset{\text{propene}}{CH_3CH=CH_2} + H_2 \xrightarrow[\text{Or Ni}]{\text{Pt}} \underset{\text{propane}}{CH_3CH_2CH_3}$

2-Reduction of Haloalkanes (alkyl halides): (by metal and acid)

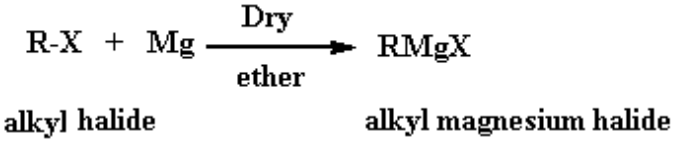
Haloalkanes may simple be hydrogenated at room temperature using a zinc-copper couple in aqueous alcohol :

$$\underset{\text{alkyl halides}}{2RX} + Zn + 2H^+ \xrightarrow[\text{aq. alcohol}]{\text{Zn–Cu /}} \underset{\text{alkane}}{2\,RH} + Zn^{2+} + X^-$$

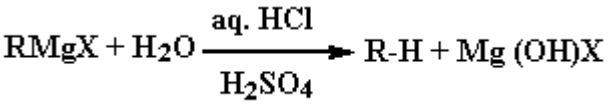


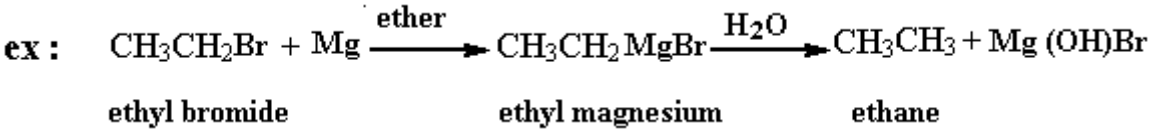
3- Grignard Reaction :

The Grignard reagent is prepared by adding a dry ether solution of an haloalkane to metallic magnesium:



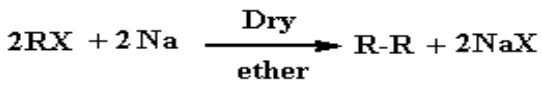
Then this reagent will treatment with aqueous hydrochloric or sulphuric acid, liberates the alkane:

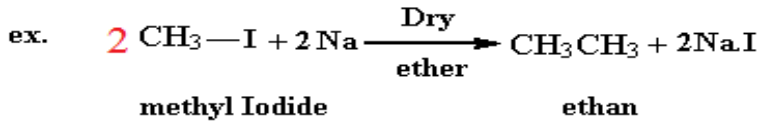




4-Wurtz Reaction:

The alkane is prepared by the reaction of metallic sodium and the Haloalkane in a dry ether solution :





Reactions of alkanes :

1- Cracking Alkanes :

The starting alkanes are broken down into a mixture of smaller alkanes , alkenes and some hydrogen :

$$\text{Alkane} \xrightarrow{400\text{-}700\ ^\circ C} \text{smaller alkanes} + \text{Alkenes} + H_2$$

$$\underset{\text{Propane}}{CH_3CH_2CH_3} \xrightarrow{400\text{-}700\ ^\circ C} CH_4 + \underset{\text{Propene}}{CH_3CH{=}CH_2} + \underset{\text{Ethene}}{CH_2{=}CH_2} + H_2$$

2-Combustion:

Alkanes burn exothermically in excess oxygen with a non-smoky flame , producing carbon dioxide and steam :

$$C_nH_{2n+2} + \frac{3n+1}{2} O_2 \xrightarrow{\text{burn}} nCO_2 + (n+1)\,H_2O \quad \Delta = -Q$$

$$\text{ex. } C_5H_{12} + 8O_2 \xrightarrow{\text{flame}} 5CO_2 + 6H_2O \qquad \Delta H = -845 \text{ kcal}$$

3- Nitration of Alkanes:

Vapor phase nitration of alkanes using nitric acid takes place at 150-400 ^oC via a free-radical mechanism, forming the nitroalkane :

$$RH + HNO_3 \xrightarrow{150\text{-}400\ ^\circ C} RNO_2 + H_2O$$

$$\underset{\text{methane}}{CH_4} + HNO_3 \xrightarrow{150\text{-}400\ ^\circ C} \underset{\text{nitromethyl}}{CH_3NO_2} + H_2O$$

Reactions involving higher alkanes yield a mixture of smaller nitro products which result from the "cracking " of the larger molecules … Nitroalkane are useful commercial solvents .

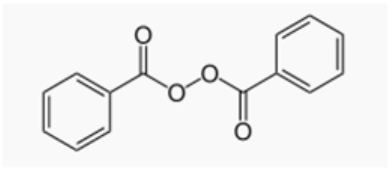
4- Chlorination of Alkanes:

Alkanes undergo chlorination in the presence of ultra-violet light or at a temperature of 250- 400 ^{o}C , yielding a mixture of products . For example, methane yields a mixture of chloromethane , CH_3Cl ,dichloromethane CH_2Cl_2 , trichloromethane $CHCl_3$,and tetrachloromethane CCl_4 .

$$CH_4 \xrightarrow[h\nu \text{ (light energy)}]{Cl_2} \text{Mixture of } CH_3Cl \text{ , } CH_2Cl_2 \text{ ,} CHCl_3 \text{ and } CCl_4$$

5- Halogenation using Sulphur Dichloride Dioxide (Sulphuryl chloride) :

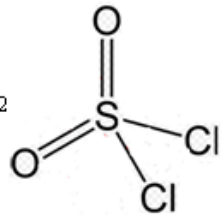
The alkane is refluxed with Sulphur dichloride dioxide at 40-80C^{O} using di(benzene carbonyl) peroxide as a catalyst :



di(benzene carbonyl) peroxide

dibenzoyl peroxide

$$RH + \underset{\text{Sulphur dichloride dioxide}}{SO_2Cl_2} \xrightarrow[40\text{-}80\,^{\circ}C]{\text{Catalyst}} \underset{\text{Haloalkane}}{RCl} + HCl + SO_2$$



Alkanes uses in pharmacy

Alkanes, which are saturated hydrocarbons with single bonds between carbon atoms, have various uses in pharmacy:

1. **Solvents**: Alkanes like hexane and heptane are often used as non-polar solvents in pharmaceutical laboratories for extracting compounds from natural sources, such as plants.
2. **Excipients**: Some alkanes, particularly longer-chain ones like paraffin wax (solid alkanes), are used as excipients in pharmaceutical formulations. They can be used in ointments, creams, and suppositories as bases or carriers for active ingredients.
3. **Lubricants**: Alkanes such as mineral oil are used as lubricants in various pharmaceutical processes and formulations. They can help in tablet coating, capsule manufacturing, and as a coating for pills.
4. **Inhalation Therapy**: Some alkanes, such as isopentane and isohexane, are used in inhalation therapy formulations. They are employed as propellants in metered dose inhalers (MDIs) and as constituents of aerosol sprays.
5. **Standard Substances**: Short-chain alkanes like methane and ethane are used as standard substances in gas chromatography, a common analytical technique used in pharmaceutical quality control.
6. **Preservatives**: Certain alkanes, like those found in essential oils (e.g., decane), can have antimicrobial properties and may be used as preservatives in pharmaceutical preparations.

These applications illustrate the versatility of alkanes in pharmacy, where they serve various roles from solvents and excipients to active ingredients and preservatives.

Questions after the lecture

اسئلة البعدية

Q1: Answer True or False of the following sentences:

1- Alkanes are colorless and possess no characteristic odor.

2- C_1 to C_4 is solids, C_5 to C_{17} are gases, and higher are liquids.

3- Alkanes increase with increasing molecular weight.

4- Branching in Alkanes contributes to reducing the density.

5- Unsaturated hydrocarbons have one or more double or triple carbon bonds.

Q2: Fill in the blanks to complete the meaning of the following sentences:

1. All alkanes are _____ and possess no characteristic _____.
2. The straight-chain alkanes, C_1 to C_4, are _____, C_5 to C_{17} are _____, and the remaining higher homologs are all _____ at 20°C.
3. Boiling points and melting points _____ with increasing molecular weight.
4. The density of alkanes _____ with increasing molecular weight, and branching contributes to _____ this factor.
5. Alkanes are non-polar and thus _____ in water but soluble in non-polar solvents such as _____, CCl_4, and _____.
6. Alkanes are _____ compounds towards many acids and bases and are not affected by oxidizing agents such as _____.
7. The non-polarity of the bonds in alkanes leads to their breaking in a _____ manner when they gain enough activation _____.
8. Alkanes react with _____, chlorine, and bromine, especially in the presence of _____.

رقم المحاضرة: االرابعة	
عنوان المحاضرة:	Hydrocarbon (11) unsaturated, (Alkenes) Nomenclature; physical properties, Structures; chemical properties; Preparation methods, Reaction of carbon-carbon, uses in pharmacy.
اســـــم المدرس:	د. بركل سليمان مصطفى
الفئة المستهدفة :	المستوى الاول
الهدف العام من المحاضرة :	تعرف على الهيدروكاربونات والكينات وكيفية تسميتها وفقًا لقواعد النظام الدولي وطرق تحضيرها واستخداماتها في الصيدلة .
الأهداف السلوكية او مخرجات التعلم:	1- التعرف على بنية الألكينات وتفاعلات الألكينات وأنواع الروابط الكيميائية داخل الجزيئات . 2- التعرف على طرق تحضير الألكينات بمختلف الطرق الكيميائية مثل عمليات لهيدروجينة والهالوجينة والتكاثف . 3- التعرف على أهمية الألكينات في الصناعات الكيميائية والصيدلانية.
استراتيجيات التيسير المستخدمة	1- استخدام الرسوم التوضيحية والرسوم البيانية لعرض الهيكل الجزيئي للألكينات والعلاقات بين الكربونات والهيدروجينات فيها. هذا يساعد على تفسير البنية والخصائص الفيزيائية والكيميائية بطريقة بصرية وسهلة الفهم. 2-استخدام المواقع والمصادر التعليمية على الإنترنت التي توفر شروحات متقدمة وأمثلة واقعية عن استخدامات الألكانات في الصيدلة والصناعة. 3- تشجيع النقاشات وتكوين المجموعات الصغيرة حول موضوع الألكانات، حيث يمكن للطلاب مناقشة الأفكار وتبادل المعرفة والخبرات، مما يعزز الفهم ويسهم في تطبيق المعلومات النظرية على سياقات واقعية.
المهارات المكتسبة	1- اكتساب القدرة على تسمية الألكينات بشكل صحيح باستخدام النظام الدولي للتسمية، مما يعزز الفهم الدقيق لتركيب وتسمية الألكانات بمختلف الأطوال الكربونية. 2-اكتساب القدرة على فهم كيفية تفاعل الألكينات مع مجموعة متنوعة من المواد الكيميائية مثل المؤكسدات، والحموض، والقواعد، والهاليدات، وتحديد التأثيرات التي قد تنشأ نتيجة لهذه التفاعلات. 3- فهم التفاعلات الكيميائية المختلفة التي يمكن أن تحدث مع الألكينات وكيفية تطبيق هذه التفاعلات في مجال الصيدلة، مثل استخدام الألكينات كمواد أساسية أو وسيطة في صناعة الأدوية.
طرق القياس المعتمدة	استخدام اختبارات كتابية تتضمن أسئلة متنوعة مثل الأسئلة الاختيارية، والأسئلة الكتابية القصيرة، والأسئلة العملية التي تتطلب من الطلاب تطبيق المفاهيم على حل مشكلات كيميائية

اسئلة القبلية

Q1: Define the following terms :

Alkenes; Polymerization

Q2: Choose the correct answer for the following sentences:

1- The general chemical formula of alkene is----------.

A- C_nH_{2n} **B- C_nH_{2n+2}** **C- C_nH_{2n+1}**

2- Dehydration of alcohols is method for preparing----------.

A-alkenes B- alkanes C- alkynes

3-The physical state of the first three members of the alkene group are ------.

A-solids B- liquids C- gases

4- The solubility of alkenes is ------- in water due to nonpolar characteristics.

A- Soluble B- Insoluble C- Slightly soluble

5- Boiling points of alkenes ------- with the number of carbon atoms.

A- Decrease B- Remain constant regardless C- Increase

Q3: Answer True or False of the following sentences:

1- Alkenes are saturated hydrocarbons containing a carbon-carbon double bond.

2- The general formula for alkenes is CnH2n

3- The first three members of the alkene group are gases.

4- Alkenes are soluble in water due to their nonpolar nature.

5- The boiling points of alkenes increase with the number of carbon atoms.

Alkenes

The alkenes form a homologous series of unsaturated hydrocarbons containing a carbon-carbon double bond , they have the general formula C_nH_{2n} , and their names end in "ene".

Naming alkenes :

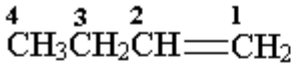
The following additional rules apply when naming alkenes:

1- Choose the longest chain of carbon atoms that contains the double bond.

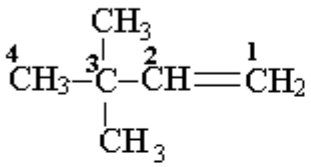
2-Number the carbon atoms in the chain from the end nearest the double bond.

3- Pick the carbon atom with the lowest number to describe the position of the double bond.

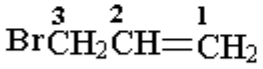
Example :



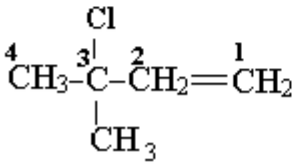
is called 1- butene



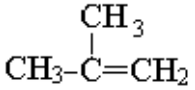
is called 3,3- dimethyl -1-butene



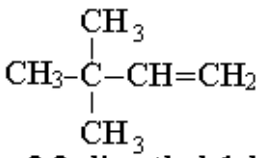
is called 3-bromo-1-propene



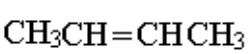
is called 3-chloro -3-methyl-1-butene



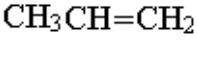
2-methyl propene



3,3-dimethyl-1-butene



2-butene



propene

Structure:

1. **General Formula**: Alkenes follow the formula CnH_2n, where n is the number of carbon atoms.
2. **Geometry**: The carbon atoms in the double bond have a trigonal planar geometry with a bond angle of about 120 degrees.
3. **Hybridization**: The carbon atoms in the double bond are sp^2 hybridized, leading to one sigma bond and one pi bond.

Physical properties of alkenes:

1) These double-bonded compounds are colourless and odorless in nature.

2) The first three members of the alkene group are gaseous in nature, the next fourteen members are liquids and the remaining alkenes are solids.

3) The alkenes are insoluble in water due to their nonpolar characteristics.

4) The boiling points of the compounds increase as the number of carbon atoms in the compound increases.

5) The boiling point of straight-chain alkenes is more that branched-chain alkenes just as in alkanes**.**

Chemical Properties of alkenes:

Alkenes are characterized by the fact that they participate in many reactions quite easily without the need for a catalyst. Their reactions are called addition reactions, and most of the reagents that react with them are symmetrical electrophilic reagents, that is, searching for negative charges, such as halogens, or asymmetrical, such as halogen acids.

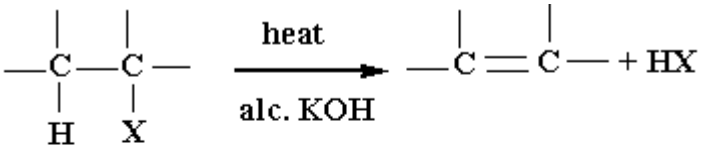
Alkenes also react with oxidizing and reducing reagents and with water in the presence of a catalytic amount with sulfuric acid. Addition reactions to alkenes are explained by adding to the double bond.

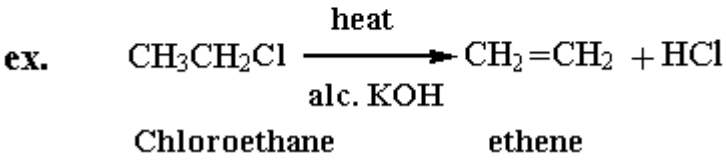
Addition reactions in alkenes lead to the breaking of a π bond in the alkene, a σ bond in the reagent, and the formation of two σ bonds in the product. Such a transformation is usually acceptable and preferable, that is, exothermic.

Preparation of alkenes :

1-Dehydrohalogenation of alkyl halides:

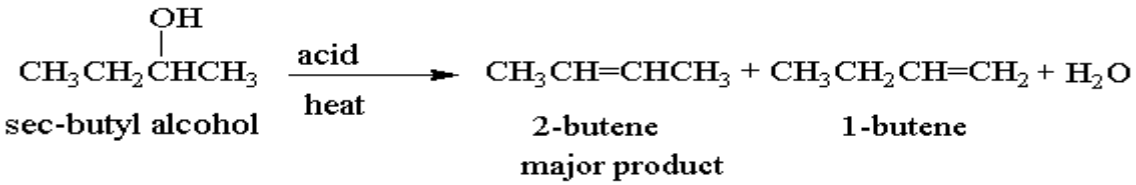
Dehydrohalogenation of alkyl halides is carried out by heating them in an alcoholic solution of potassium hydroxide





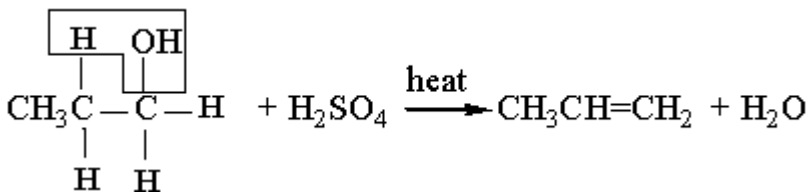
a mixture of alkenes is usually produced when preparing higher homologous ,the relative proportion of which depends on the respective stabilities of the individual alkenes.

A mixture of alkenes is usually produced when preparing higher homologous , the relative proportion of which depends on the respective stabilities of the individual alkenes .

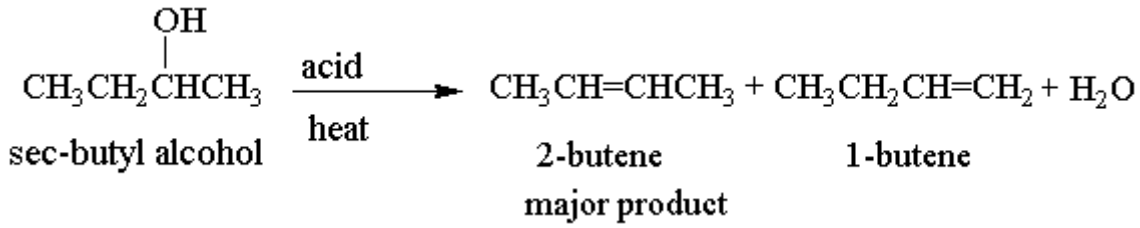


2-Dehydration of alcohols:

In this reaction ,a molecule of water is eliminated from an alcohol molecule by heating the alcohol in the presence of a strong mineral acid , A double bond forms between the adjacent carbon atoms that lost the hydrogen ion and hydroxide group.



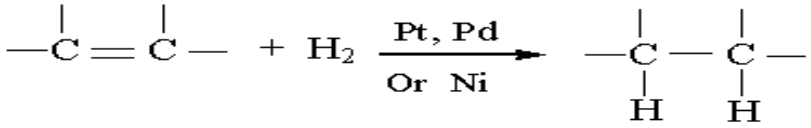
A mixture of alkenes is usually produced when preparing higher homologous , the relative proportion of which depends on the respective stabilities of the individual alkenes .

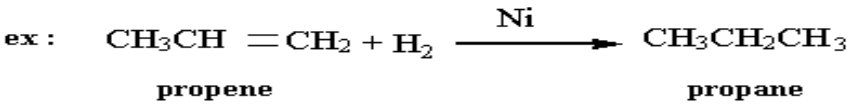


Chemical reactions of Alkenes ;

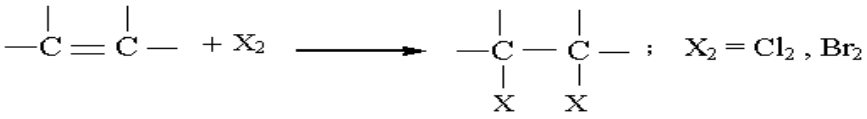
1-Addition of hydrogen:

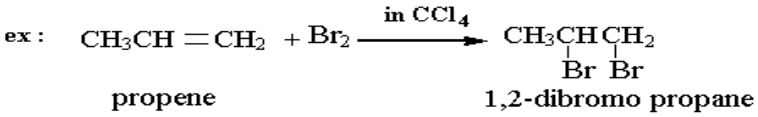
Alkenes are hydrogenated by passing them over a finely divided platinum, palladium or nickel catalyst in an atmosphere of hydrogen :





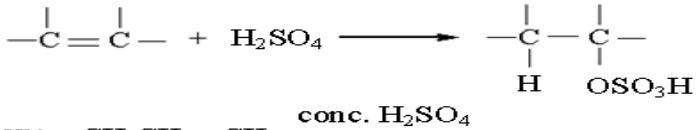
2- Addition of halogens:

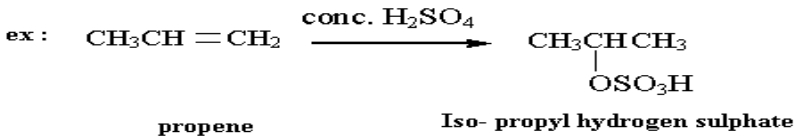




3- Addition of Sulphuric acid :

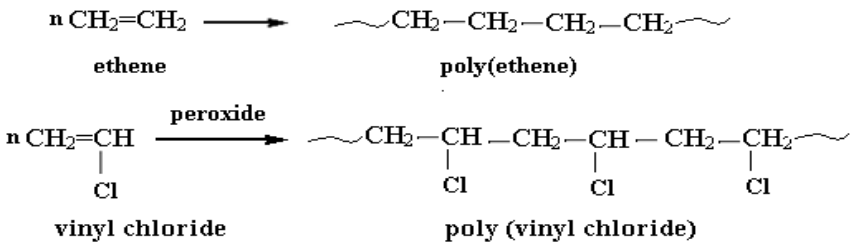
Simple alkenes react with cold (0-15 ^{o}C) ,concentrated sulphuric acid to form **alkyl hydrogen sulphate** , which dissolve in the acid **later** to form a colorless solution :





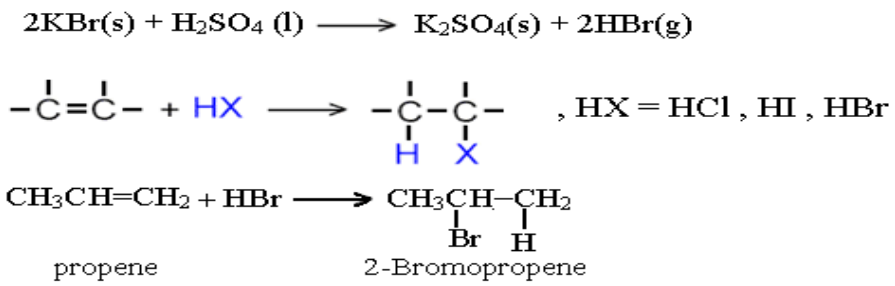
4- Polymerization :

The process obtain by which many simple molecules join together to form very large molecules is known as polymerization ,Simple alkenes polymerize to form a family of long – chain "addition polymers ".



5- Addition of hydrogen halides :

Hydrogen halide, generated by the reaction of an alkkali metal halide with concentrated sulphuric acid ,which react rapidly with alkenes at room temp. yielding the alklhalides :



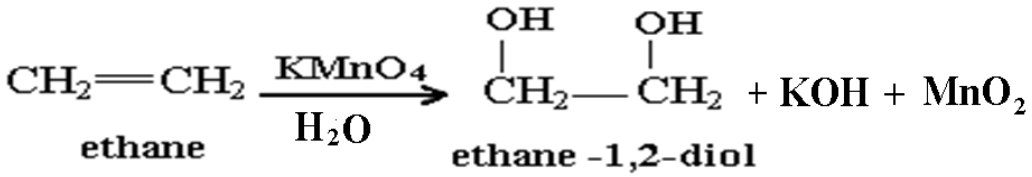
6- Combustion :

Alkenes burn in a plentiful of oxygen to form carbon dioxide and water :

$$H_2C{=}CH_{2(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O\ (l)$$

7- Oxidation :

Alkenes can be oxidized by cold ,slightly alkaline potassium permanganate to make substances called 1,2-diols .containing two OH groups on adjacent carbon atoms .The potassium permangate solution turns from purple to brown, this is a test is often used to detect unsaturation in a hydrocarbon (**baeyer test**).



Alkenes uses in pharmacy

Alkenes, which are hydrocarbons containing at least one carbon-carbon double bond, also find several important uses in pharmacy:

1. **Drug Synthesis**: Alkenes serve as starting materials or intermediates in the synthesis of various drugs. Organic chemists utilize alkenes in reactions such as hydrogenation, hydrohalogenation, and addition reactions to create pharmaceutical compounds.
2. **Polymerization**: Ethylene, the simplest alkene, is crucial in the production of polyethylene, which is used extensively in pharmaceutical packaging materials (e.g., plastic bottles, bags) and medical devices.
3. **Excipients and Delivery Systems**: Polymers derived from alkenes, such as polyethylene glycol (PEG), are used as excipients in drug formulations. PEG is known for its solubilizing properties and is used in formulations to enhance drug delivery and stability.
4. **Surfactants**: Alkenes and their derivatives are used as surfactants in pharmaceutical formulations. For instance, certain alkenes can be used to stabilize emulsions or act as wetting agents in ophthalmic solutions.
5. **Co solvents**: Some alkenes, like propylene glycol and polypropylene glycol, are used as co solvents in pharmaceutical preparations. They can enhance the solubility of poorly soluble drugs and improve their bioavailability.
6. **Inhalation Therapy**: Alkenes such as ethylene and propylene are used as propellants in aerosol formulations for inhalation therapy, where they help deliver medication in a fine mist form.
7. **Antioxidants and Preservatives**: Some alkenes and their derivatives have antioxidant properties, which can help preserve the stability and efficacy of pharmaceutical formulations.

Questions after the lecture

اسئلة البعدية

Q1: Write structural formula for the following:

2-methyl propene **;** 2,3-dimethyl-2-hexene

Q2:Complete the following eqations :

$$CH_3CH_2CH{=}CH_2 + Br_2 \xrightarrow{\text{in CCl4}}$$

butene

$$CH_3CH{=}CHCH_2CH_3 + H_2 \xrightarrow{Ni}$$

2- hexene

Q3: Choose the correct answer for the following sentences:

1- One method for preparing alkenes is ----------.
A- Hydrogenation of alkanes B- Dehydrohalogenation of alkyl halides
C- Hydrolysis of esters

2- Dehydration of alcohols is method for preparing----------.
A-Alkenes B- Alkanes C- Alkynes

3- Haloalkanes may simple be hydrogenated at room temperature using -------
couple in aqueous alcohol to prepared alkane.
A- zinc-copper B- zinc-sodium C- zinc-nickel

4- The product of the combustion of alkenes in excess oxygen is ---- and water.
A- Carbon monoxide B- Carbon dioxide C- Carbon trioxide

5- When alkenes are oxidized by cold potassium permanganate formed is -----.
A-Ketones B-) 1,2-diols C- Aldehydes

Q4: Fill in the blanks to complete the meaning of the following sentences

1-These double-bonded compounds are _____ and _____ in nature.

2-The first three members of the alkene group are _____ in nature, the next fourteen members are _____, and the remaining alkenes are _____.

3-Alkenes are insoluble in water due to their _____ characteristics.

4-The boiling points of the compounds increase as the _____ in the compound increases.

5-The boiling point of straight-chain alkenes is more than _____ alkenes just as in alkanes.

رقم المحاضرة: الخامسة	
عنوان المحاضرة:	Cyclo Alkane; Nomenclature; physical & chemical properties, Structures; reaction preparation methods.
اســـــم المدرس:	د. بركل سليمان مصطفى
الفئة المستهدفة :	المستوى الاول
الهدف العام من المحاضرة :	تعرف على تركيب السيكلو ألكانات كفئة من الهيدروكربونات وكيفية تسميتها وفقا لقواعد النظام الدولي وطرق تحضيرها .
الأهداف السلوكية او مخرجات التعلم:	1- التعرف على بنية وتسمية سايكلو الألكانات بشكل صحيح باستخدام نظام التسمية (IUPAC). 2- التعرف على طرق تحضير سايكلو الألكانات بمختلف الطرق الكيميائية 3- التعرف على الخصائص الفيزيائية للسيكلو ألكانات مثل نقطة الغليان والكثافة ودرجة الذوبان..
استراتيجيات التيسير المستخدمة	1- استخدام نماذج ثلاثية الأبعاد أو الرسوم البيانية لعرض الهياكل الجزيئية وكيفية تفاعل السيكلو ألكانات. 2- تقديم عروض مرئية تتضمن مقاطع فيديو أو صور توضيحية لخصائص السيكلو ألكانات واستخداماتها. 3- تشجيع النقاشات وتكوين المجموعات الصغيرة حول موضوع سايكلو الألكانات، حيث يمكن للطلاب مناقشة الأفكار وتبادل المعرفة والخبرات، مما يعزز الفهم ويسهم في تطبيق المعلومات النظرية على سياقات واقعية.
المهارات المكتسبة	1- اكتساب القدرة على تسمية سايكلو الألكانات بشكل صحيح باستخدام النظام الدولي للتسمية، مما يعزز الفهم الدقيق لتركيب وتسمية سايكلو الألكانات بمختلف حلقات . 2-اكتساب القدرة على رسم الهياكل الجزيئية للسيكلو ألكانات وفهم الروابط بين الذرات. 3- القدرة على تحليل الخصائص الفيزيائية للسيكلو ألكانات وتأثيرها على سلوك المركبات.
طرق القياس المعتمدة	استخدام اختبارات كتابية تتضمن أسئلة متنوعة مثل الأسئلة الاختيارية، والأسئلة الكتابية القصيرة، والأسئلة العملية التي تتطلب من الطلاب تطبيق المفاهيم على حل مشكلات كيميائية

Q1: Define the Cycloalkanes

Q2: Choose the correct answer for the following sentences:

1- The general chemical formula of **Cycloalkanes** is----------.

A- C_nH_{2n} **B-** C_nH_{2n+2} **C-** C_nH_{2n+1}

2- The states can cycloalkanes exist in at room temperatureare -----.

A-Only gases B- Gases, liquids, or solids C- Only liquids

3-The boiling and melting points of cycloalkanesare ----- compare to their straight-chain counterparts.

A- Lower B- Higher C-The same

4- The solubility of cycloalkanes is -------- in water

A- soluble B- insoluble C- partially soluble

5-The density of cycloalkanes is ----- compare to water.

A- Typically denser B- less dense C- The same density

Q3: Answer True or False of the following sentences:

1- Smaller cycloalkanes, like cyclopropane, experience less ring strain than larger cycloalkanes.

2-Cycloalkanes can be gases, liquids, or solids at room temperature depending On the number of carbon atoms in the ring.

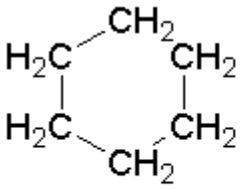
3-Cycloalkanes have lower boiling and melting points than their straight-chain counterparts due to increased van der Waals forces.

4-Cycloalkanes are soluble in water because they are polar compounds.

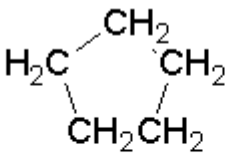
5-Cycloalkanes typically have a density greater than that of water.

Cycloalkanes

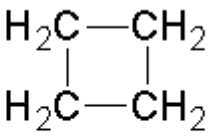
The cycloalkanes with one ring have the general formula CnH2n, and are named by adding the prefix cyclo- to the name of the corresponding continuous-chain alkane having the same number of carbon atoms as the ring



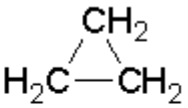
Cyclohexane



Cyclopentane



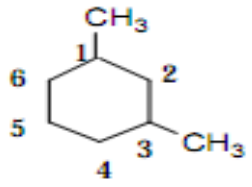
Cyclobutane



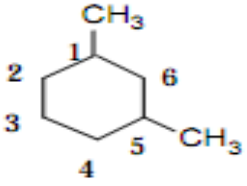
Clclopropane

Structure and nomenclature

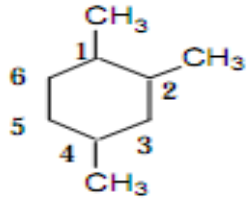
Add the prefix cyclo- to the name of the open-chain alkane containing the same number of carbons. If only one substituent, no need to give it a number. If two substituents, number from the substituent of lower alphabetical order. If three or more substituents, number to give them the lowest set of numbers and then list substituents in alphabetical order.



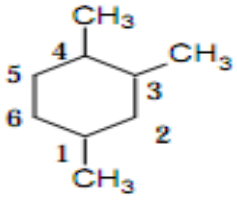
1,3-Dimethylcyclohexane



-not-
1,5-Dimethylcyclohexane



1,2,4-Trimethylcyclohexane
(1 + 2 + 4 = 7)



-not-
1,3,4-Trimethylcyclohexane
(1 +3 + 4 = 8)

Physical Properties of Alkanes and Cycloalkanas:

Compounds	Bp, °C	Mp, °C	Density, d_4^{20}, g ml^{-1}
propane	−42	−187	0.580[a]
cyclopropane	−33	−127	0.689[a]
butane	−0.5	−135	0.579[b]
cyclobutane	13	−90	0.689[b]
pentane	36	−130	0.626
cyclopentane	49	−94	0.746
hexane	69	−95	0.659
cyclohexane	81	7	0.778
heptane	98	−91	0.684
cycloheptane	119	−8	0.810
octane	126	−57	0.703
cyclooctane	151	15	0.830
nonane	151	−54	0.718
cyclononane	178	11	0.845

Physical Properties of Cycloalkanes:

1. **State**: Cycloalkanes can be gases, liquids, or solids at room temperature, depending on the number of carbon atoms in the ring.
2. **Boiling and Melting Points**: Cycloalkanes generally have higher boiling and melting points than their straight-chain counterparts due to increased van der Waals forces. The boiling point increases with the number of carbon atoms.
3. **Solubility**: Cycloalkanes are non-polar and insoluble in water, but they are soluble in organic solvents like hexane and benzene.
4. **Density**: Cycloalkanes are typically less dense than water, similar to alkanes.

Chemical Properties of Cycloalkanes:

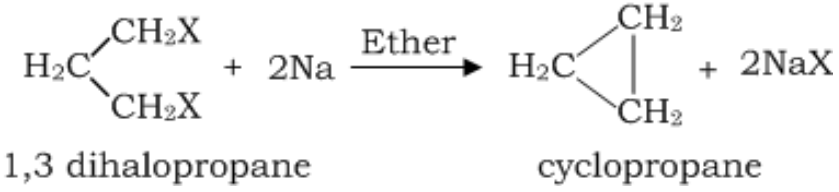
1. **Reactivity**: Cycloalkanes are relatively stable due to their saturated nature, but they can undergo reactions similar to alkanes.
2. **Substitution Reactions**: Cycloalkanes can participate in free radical halogenation, leading to substituted products (e.g., chlorinated or brominated cycloalkanes).
3. **Ring Strain**: Smaller cycloalkanes (e.g., cyclopropane, cyclobutane) experience ring strain due to bond angle deviations from the ideal tetrahedral angle (109.5°), making them more reactive than larger cycloalkanes (e.g., cyclohexane).
4. **Cyclohexane Chair Conformation**: Cyclohexane adopts a chair conformation, which minimizes strain and is more stable than other conformations (like boat).

These properties are essential for understanding the behavior of cycloalkanes in chemical reactions and their applications in various fields.

Preparation of cycloalkanes

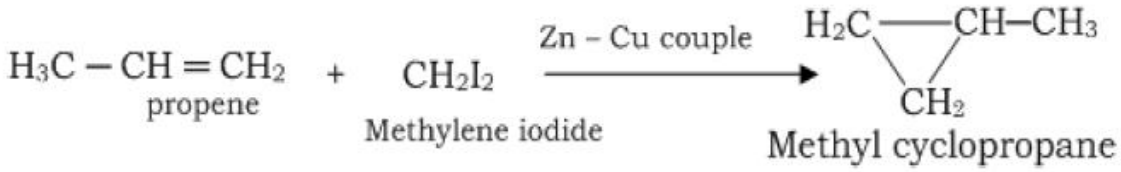
1. From dihalogen compounds : From **dihalides** having halogen atoms on two ends of carbon chain with Na or Zn gives rise to the formation of cycloalkanes.

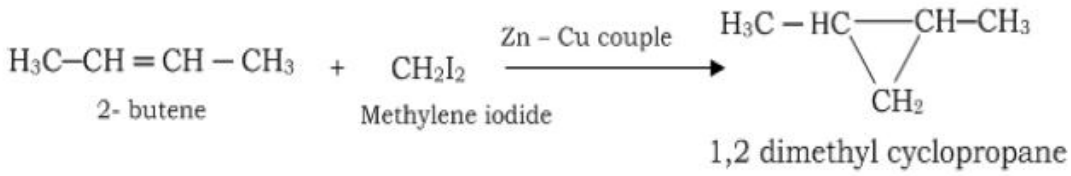
$$Br-(CH_2)_n-Br + Zn \longrightarrow \overbrace{(CH_2)_n} + ZnBr_2$$



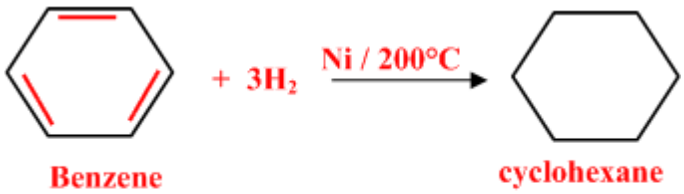
1,3 dihalopropane cyclopropane

2. From alkenes : Alkenes on treating with **CH_2I_2** in presence of Zn-Cu couple or by **diazomethane (CH_2N_2)** in presence of **U.V. light** gives derivatives of cycloalkanes.



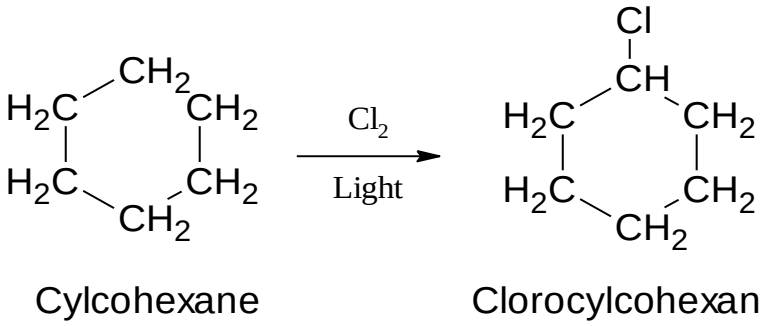


3. **From aromatic compounds**: cyclohexane can be prepared by the catalytic hydrogenation of benzene.

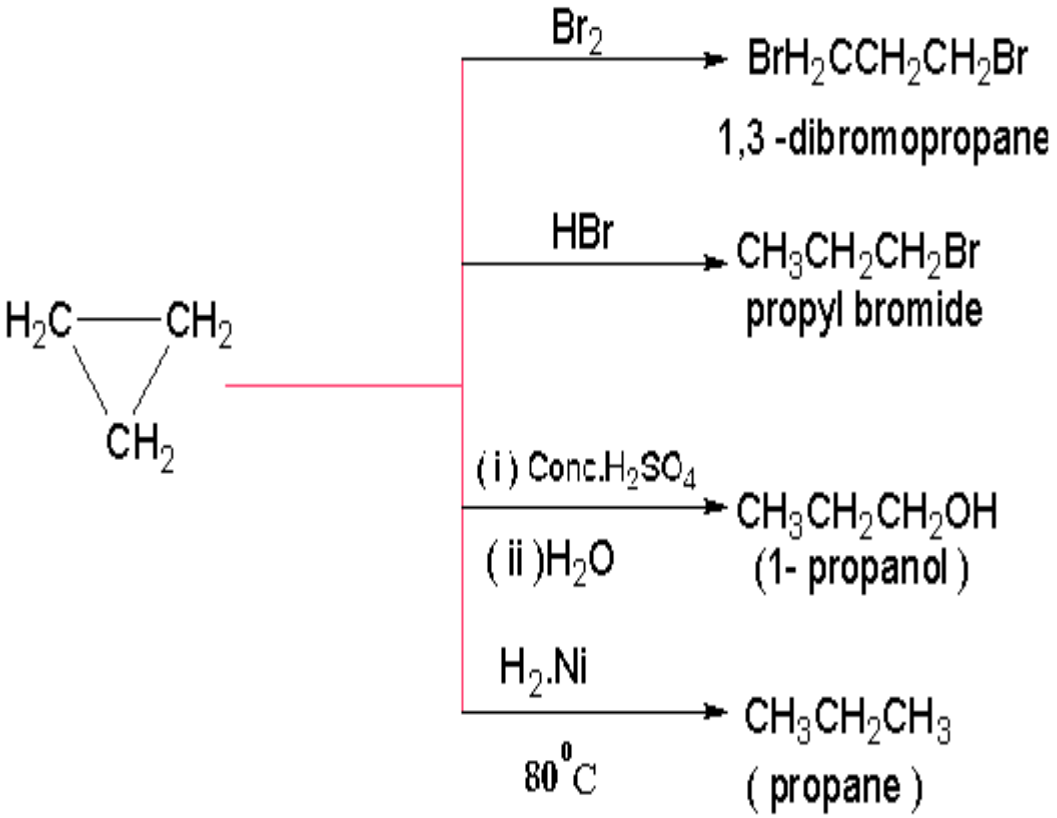


Reactions of cycloalkanes

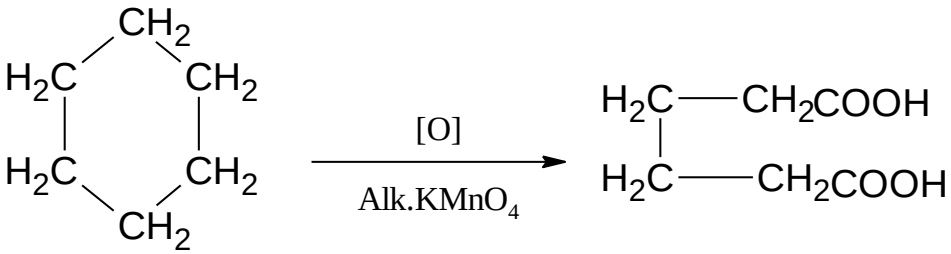
1- Free radical substitution : Cycloalkanes are halogenated in presence of sun light or UV light like alkane.



2-Addition reactions: Cyclopropane being the most strained ring and more reactive undergoes addition reactions like alkenes.



3- Oxidation: Cycloalkanes are oxidized by alkaline potassium permanganate to dicarboxylic acids involving ring fusion



Questions after the lecture **اسئلة البعدية**

Ql : Enumerate the methods for preparing Cycloalkane and give an example for each method

Q2: What is the result of the reaction of cyclopropane C_3H_6 with the following substances:

Br_2 , HBr , con.H_2SO_4; H_2O , H_2; Ni

Q3: What is the result of oxidation of cyclohexane C_6H_{12} by alkaline potassium permanganate.

Q4: Fill in the blanks to complete the meaning of the following sentences:

1-Cycloalkanes can be gases, liquids, or _____ at room temperature, depending on the number of carbon atoms in the ring.

2-Cycloalkanes generally have _____ boiling and melting points than their straight-chain counterparts due to increased van der Waals forces.

3-Cycloalkanes are non-polar and _____ in water, but they are soluble in organic solvents like hexane and benzene.

4-Cycloalkanes are typically _____ dense than water, similar to alkanes.

5-Cycloalkanes are relatively stable due to their _____ nature, but they can undergo reactions similar to alkanes.

Q5: Answer True or False of the following sentences:

1-Smaller cycloalkanes, like cyclopropane, experience torsional strain due to bond angle deviations from the ideal tetrahedral angle (109.5°).

2- Cyclopropane has bond angles of approximately 60°, which deviate significantly from the ideal tetrahedral angle, causing torsional strain.

3- Cycloalkanes are halogenated in presence of sun light or UV light like alkane.

4- Cyclohexane can be prepared by the catalytic hydrogenation of benzene.

5- Alkenes on treating with CH_2I_2 in presence of Zn-Cu couple or by diazomethane (CH_2N_2) in presence of U.V. light give derivatives of cycloalkanes.

رقم المحاضرة: السادسة	
عنوان المحاضرة:	Hydrocarbons (111) (Alkynes) Nomenclature; physical & chemical properties, reaction preparation methods.
اســـــم المدرس:	د. بركل سليمان مصطفى
الفئة المستهدفة :	المستوى الاول
الهدف العام من المحاضرة :	تعرف على تركيب الكاينات كفئة من الهيدروكربونات وكيفية تسميتها وفقا لقواعد النظام الدولي وطرق تحضيرها .
الأهداف السلوكية او مخرجات التعلم:	1- التعرف على بنية وتسمية الألكاينات بشكل صحيح باستخدام نظام التسمية (IUPAC). 2- التعرف على طرق تحضير الألكاينات بمختلف الطرق الكيميائية 3- التعرف على الخصائص الفيزيائية ألكاينات مثل نقطة الغليان والكثافة ودرجة الذوبان وفهم تأثير الروابط الثلاثية على الخصائص.
استراتيجيات التيسير المستخدمة	1- استخدام نماذج ثلاثية الأبعاد أو الرسوم البيانية لعرض الهياكل الجزيئية وكيفية تفاعل ألكاينات. 2- تقديم عروض مرئية تتضمن مقاطع فيديو أو صور توضيحية لخصائص السيكلو ألكاينات واستخداماتها. 3-تشجيع النقاشات وتكوين المجموعات الصغيرة حول موضوع الألكاينات، حيث يمكن للطلاب مناقشة الأفكار وتبادل المعرفة والخبرات، مما يعزز الفهم ويسهم في تطبيق المعلومات النظرية على سياقات واقعية.
المهارات المكتسبة	1- اكتساب القدرة على تسمية الألكاينات بشكل صحيح باستخدام النظام الدولي للتسمية، مما يعزز الفهم الدقيق لتركيب 2- القدرة على مقارنة الألكينات مع الألكانات والألكينات من حيث الخواص والتفاعلات. 3- فهم كيفية تفاعل الألكينات مع المركبات الأخرى (مثل الهدرجة، الهالوجين، وغيرها).
طرق القياس المعتمدة	استخدام اختبارات كتابية تتضمن أسئلة متنوعة مثل الأسئلة الاختيارية، والأسئلة الكتابية القصيرة، والأسئلة العملية التي تتطلب من الطلاب تطبيق المفاهيم على حل مشكلات كيميائية

اسئلة القبلية

Q1: Choose the correct answer for the following sentences:

1- Alkynes are -------- in water.

A. Highly soluble. B. insoluble but quite soluble in organic solvents like benzene and ether. C. equally soluble and organic solvents.

2- How do alkynes generally compare to water in terms of density?

A. Alkynes are more dense than water. B. Alkynes are less dense than water.

C. Alkynes have the same density as water.

3-What happens to the boiling point of alkynes as their molecular weight increases?

A. The boiling point decreases. B. The boiling point remains constant.

C. The boiling point increases.

4- Alkynes more reactive than alkenes and alkanes Due to the presence of----.

A. Double bonds. B.Triple bonds. C. Both double and triple bonds.

5- Which reaction allows alkynes to react with hydrogen in the presence of a catalyst to form alkenes or alkanes?

A. Halogenation B. Hydrogenation C. Hydration

Q2: Answer True or False of the following sentences:

1- Terminal alkynes can react with hydrogen halides to form haloalkenes or haloalkanes, often following Markovnikov's rule.

2- Aromatic alkynes are more acidic and can react with strong bases to form acetylide anions.

3- In the presence of acids and water alkynes be oxidized to form carbonyl

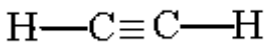
Compounds like ketones.

4- Alkynes are highly soluble in water due to their polar nature.

5- Alkynes are less reactive than alkenes and alkanes due to the presence of the triple bond

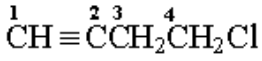
Alkynes

The alkynes are a family of hydrocarbons that contain a carbon-carbon triple bond, with the general formula $\mathbf{C_nH_{2n-2}}$, The first member of the family is ethyne (old name acetylene). Ethyne (C_2H_2) is linear molecule :

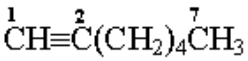


Naming alkynes :

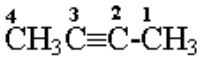
The IUPAC names of alkynes are afforded by taking the stem of the name of the corresponding alkane and replacing the ending "**ane**" of the alkane with the suffix "**yne**" .The position of the triple bond is the stem and the ending .



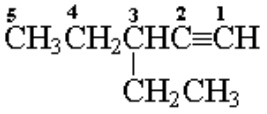
4-chloro-1-butyne



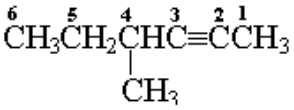
1-heptyne



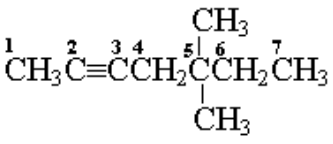
2-butyne



3-ethyl-1-pentyne



4-methyl-2-hexyne



5,5-dimethyl-2-heptyne

Physical properties of Alkynes :

The alkynes have physical properties that are essentially the same as those of the alkanes and alkenes .They are :

1- In soluble in water but quite soluble in the usual organic solvents such as benzene ether ,and carbon tetrachloride.

2- Alkynes are less dense than water ..

3- Their boiling point increase with increasing molecular weight .

4- Alkynes from C_2 to C_4 are gases , C_5 to C_{18} liquids, and those with more than eighteen carbons are solids

Chemical Properties of Alkynes:

1. **Reactivity**:
    - Alkynes are more reactive than alkenes and alkanes due to the presence of the triple bond.

2. **Addition Reactions**:
    - **Hydrogenation**: Alkynes can react with hydrogen (H_2) in the presence of a catalyst (e.g., Pd, Pt) to form alkenes or alkanes, depending on the extent of hydrogenation.
    - **Halogenation**: They can react with halogens (e.g., Br_2, Cl_2) to form dihaloalkenes or dihaloalkanes, depending on the reaction conditions.
    - **Hydrohalogenation**: Alkynes react with hydrogen halides (e.g., HCl, HBr) to form haloalkenes or haloalkanes, often leading to Markovnikov's addition.
    - **Hydration**: In the presence of acid and water (often with a catalyst like $HgSO_4$), alkynes can be hydrated to form ketones or aldehydes, depending on the structure of the alkyne.
3. **Acidity**:
    - Terminal alkynes (alkynes with the triple bond at the end of the carbon chain) are more acidic than alkenes and alkanes, allowing them to react with strong bases (e.g., sodium amide, $NaNH_2$) to form acetylide anions.
4. **Polymerization**:
    - Some alkynes can undergo polymerization reactions to form polymers, though this is less common than with alkenes.
5. **Oxidation**:
    - Alkynes can be oxidized to form carbonyl compounds (like ketones) under certain conditions, such as with ozone (ozonolysis).

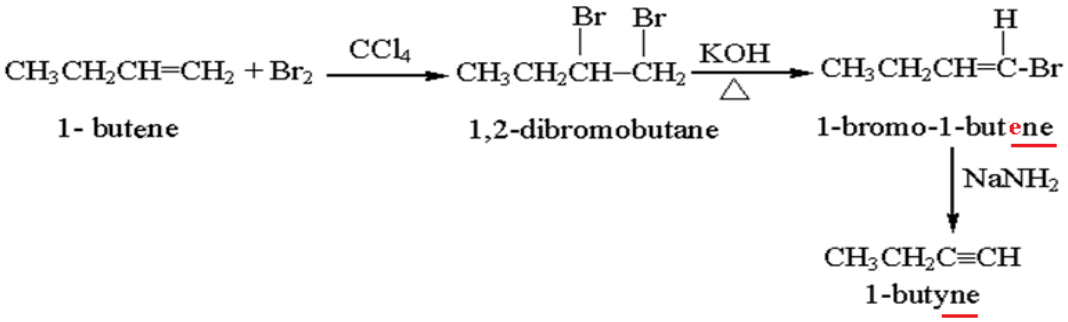
These properties make alkynes versatile in organic synthesis and industrial applications.

Preparation of alkynes :

Alkynes are synthesized by **three** methods:

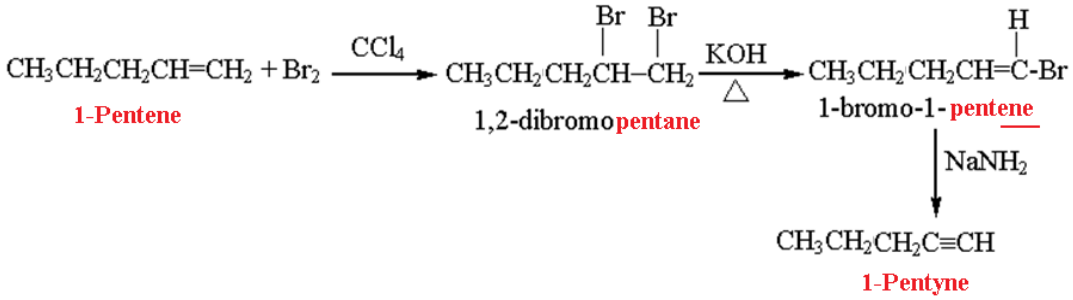
1-Dehydrohalogenation of alkyl halides:

This reaction is ageneral method for the conversion of alkenes to alkynes :



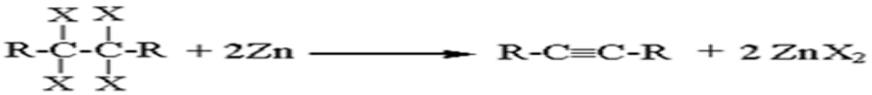
Home work :

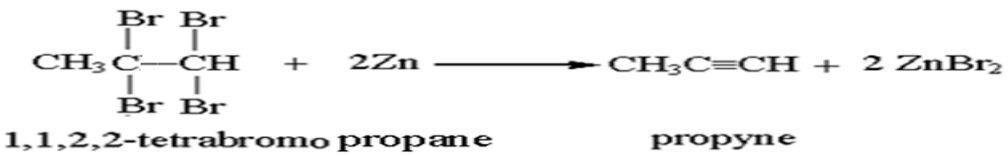
Starting with **1-pentene** ,show how would you prepare **1-pentyne** .



2-Dehalogenation of Tetrahalides :

Reaction of zinc with 1,1,2,2-tetrahalides yields alkynes :





3-Reaction of Sodium acetylide with primary alkylhalides :

Acetylene and monosubstituted acetylenes , R-C ≡C-H,contain ahydrogen atom attacked to atriple –bonded carbon atom.such acetylenic hydrogenes are found to be
acidic , and may be replaced by certain metaals to form salts known as metal acetylides.

For example , sodium in liquid ammonia reacts with acetylene to form a sodium acetylide salt and hydrogen.

$$H\text{-}C{\equiv}C\text{-}H + Na \xrightarrow[NH_3]{\text{liquid}} \underset{\text{sodium acetylide}}{H\text{-}C{\equiv}C{:}^{-}\ Na^{+}} + \frac{1}{2}H_2\uparrow$$

This sodium salt can react with primary alkyl halides to form higher alkynes with the triple bond at the end at of the chain.

ex: $H\text{-}C{\equiv}C{:}^{-}\ Na^{+} + \underset{\text{methyl bromide}}{CH_3Br} \longrightarrow \underset{\text{propyne}}{H\text{-}C{\equiv}C\text{-}CH_3} + NaBr$

$H\text{-}C{\equiv}C{:}^{-}\ Na^{+} + \underset{\text{ethyl iodide}}{CH_3CH_2I} \longrightarrow \underset{\text{1-butyne}}{H\text{-}C{\equiv}C\text{-}CH_2CH_3} + NaI$

Reactions of Alkynes :

1-Addition of Hydrogen:

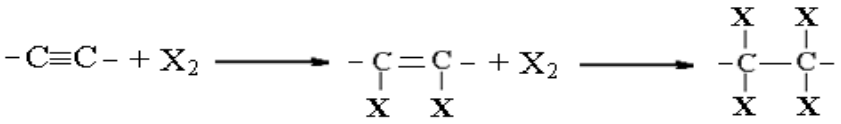
Alkynes may add hydrogen in the presence of suitable cataysts ,such as platinum, palladium, or nickel the final product is always an alkan.

$$\underset{\text{alkyne}}{-C{\equiv}C-} \xrightarrow[Ni]{2H_2} \underset{\text{alkane}}{\overset{H\ H}{\underset{H\ H}{-C-C-}}}$$

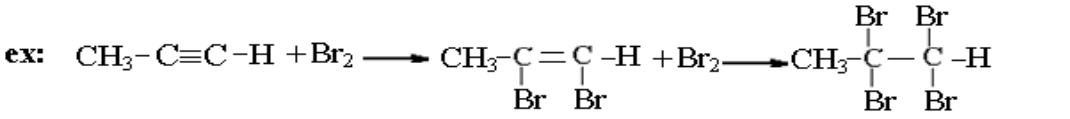
ex: $\underset{\text{2-butyne}}{CH_3-C{\equiv}C-CH_3} \xrightarrow[Ni]{2H_2} \underset{\text{n-butane}}{CH_3CH_2CH_2CH_3}$

2- Addition of halogen :

Alkynes react with two molecules of halogen to give tetrahalides , this reaction is restricted to chlorine and bromoine .



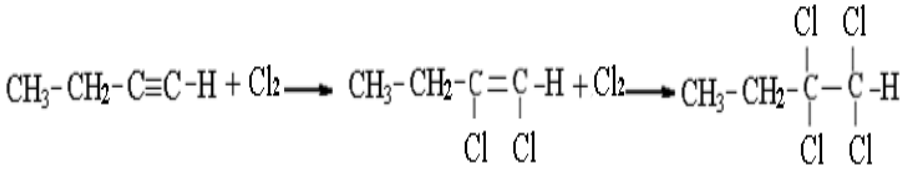
where X_2= Cl_2 , Br_2 trtra halide



propyne 1,2– dibromopropene 1,1,2,2-tetrabromo-propane

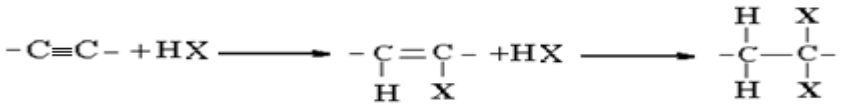
Homework

Starting from 1-butyne , prepare 1,1,2,2-tetrachlorobutane .



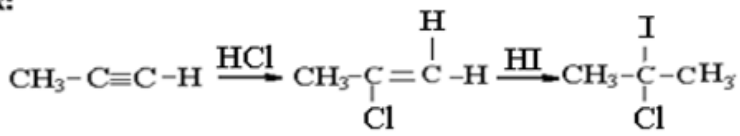
1-butyne 1,2-dichlorobutene 1,1,2,2-tetrachlorobutane

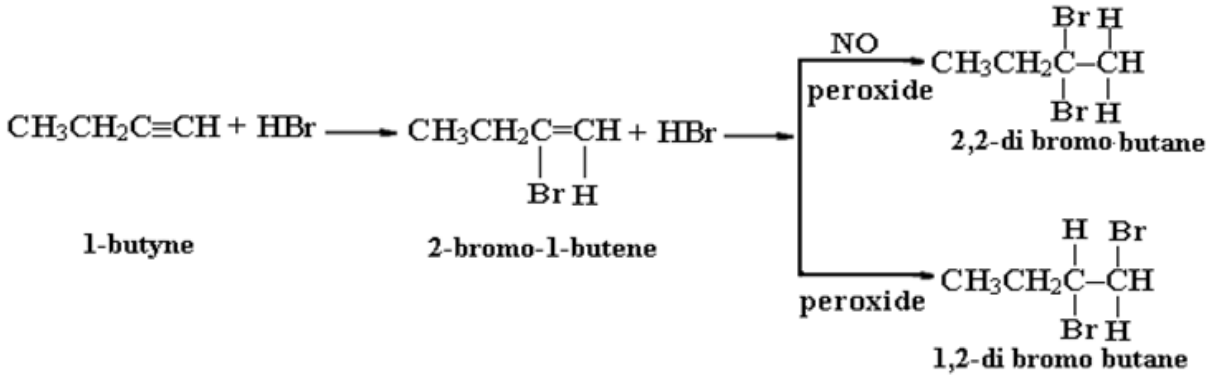
3- Addition of hydrogen halide :



haloalkane gem -dihalide

ex:





1-butyne 2-bromo-1-butene 2,2-di bromo butane 1,2-di bromo butane

Questions after the lecture **اسئلة البعدية**

Q1: **Write structures for the following compound :**

3-Octyne ; $CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}C{\equiv}CH$

Q2: Complete the following eguations :

1- $CH_3\text{-}C{\equiv}CH + ? \longrightarrow CH_3\text{-}CCl{=}CHCl$

2- $CH_3C(Cl)(Cl)\text{-}C(Cl)(Cl)\text{-}CH_3 + 2\,Zn \longrightarrow ?$

3- $CH_3C{\equiv}CH + \xrightarrow[Ni]{2H_2} ?$

Q3; Fill in the blanks to complete the meaning of the following sentences

1-Alkynes are _____ in water but quite soluble in organic solvents such as benzene and ether.

2-Alkynes are _____ dense than water.

3-The boiling point of alkynes _____ with increasing molecular weight.

4-Alkynes from C2 to C4 are _____, C5 to C18 are _____, and those with more than eighteen carbons are _____.

5-Alkynes are more reactive than alkenes and alkanes due to the presence of the _____ bond.

6-Alkynes can react with hydrogen (H_2) in the presence of a catalyst (e.g., Pd, Pt) to form _____ or _____, depending on the extent of hydrogenation.

7-Alkynes react with halogens (e.g., Br_2, Cl_2) to form _____ or _____, depending on the reaction conditions.

8-Terminal alkynes (alkynes with the triple bond at the end of the carbon chain) are more _____ than alkenes and alkanes, allowing them to react with strong bases to form _____ anions.

9- Alkynes can be oxidized to form _____ compounds under certain conditions, such as with ozone (ozonolysis).

10- Alkynes react with two molecules of halogen to give tetrahalides , this reaction is restricted to _____ and _____.

رقم المحاضرة: السابعة	
عنوان المحاضرة:	Aromatic hydrocarbon (Benzene) structures & Bonding; Nomenclature of aromatic hydrocarbon; chemical properties of Benzene Electrophilic aromatic substitution
اســـــم المدرس:	د. بركل سليمان مصطفى
الفئة المستهدفة :	المستوى الاول
الهدف العام من المحاضرة :	تعرف على التركيب الهندسي للبنزين (C_6H_6) وتحديد نظام الروابط و فهم طبيعة الروابط المزدوجة المتناوبة وكيفية تسميتها وفقًا لقواعد النظام الدولي وطرق تحضيرها .
الأهداف السلوكية او مخرجات التعلم:	1- التعرف على تسمية المركبات العطرية بشكل صحيح وفقًا لقواعد التسمية الكيميائية 2- التعرف على طرق تحضير البنزين بمختلف الطرق الكيميائية 3- التعرف على الخصائص الفيزيائية لبنزين مثل نقطة الغليان والكثافة ودرجة الذوبان
استراتيجيات التيسير المستخدمة	1- استخدام نماذج ثلاثية الأبعاد أو الرسوم البيانية لعرض الهياكل الجزيئية وكيفية تفاعل المركبات العطرية . 2- تقديم عروض مرئية تتضمن مقاطع فيديو أو صور توضيحية لخصائص مركبات اورماتية واستخداماتها. 3- تشجيع النقاشات وتكوين المجموعات الصغيرة حول موضوع البنزين ، حيث يمكن للطلاب مناقشة الأفكار وتبادل المعرفة والخبرات، مما يعزز الفهم ويسهم في تطبيق المعلومات النظرية على سياقات واقعية.
المهارات المكتسبة	1- اكتساب القدرة على تفسير البنية الجزيئية للبنزين وكيفية توزيع الإلكترونات. 2- اكتساب مهارات تسمية المركبات العطرية وفق نظام IUPAC. و التمييز بين الأسماء الشائعة والرسمية وفهم تركيب المجموعات الوظيفية. 3- تحليل خصائص البنزين ومقاومته للتفاعلات الإضافية
طرق القياس المعتمدة	استخدام اختبارات كتابية تتضمن أسئلة متنوعة مثل الأسئلة الاختيارية، والأسئلة الكتابية القصيرة، والأسئلة العملية التي تتطلب من الطلاب تطبيق المفاهيم على حل مشكلات كيميائية

Q1: Choose the correct answer for the following sentences:

1- What general property describes aromatic compounds regarding their interaction with water?

A. They are highly soluble in water. B. They are immiscible in water.

C. They form a colloidal solution in water.

2- Why are aromatic compounds useful as solvents for other nonpolar compounds?

A. Due to their high reactivity B. Because they are highly polar

C. Due to their nonpolar nature and low reactivity

3- What characteristic flame color is exhibited by aromatic compounds due to their high ratio of carbon to hydrogen?

A. Blue B. Yellow C. Red

4- What is the physical state of benzene under normal conditions?

A. Solid B. Gas C. Liquid

5- At what temperature does benzene boil?

A. 60.3°C B. 70.5°C C. 80.1°C

Q2: Answer True or False of the following sentences:

1-Toluene undergoes nitration using nitric acid in a 1:2 mixture with sulfuric acid, resulting in a mixture of 2-, 3-, and 4-nitromethylbenzenes.

2-Benzene can undergo halogenation to form polyhalocyclohexanes under strong irradiation.

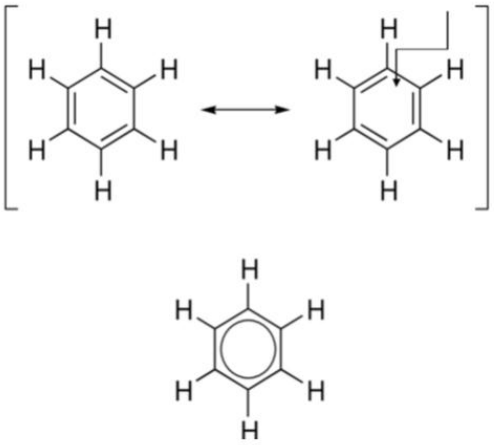
3- Alkylation of alkylbenzenes typically utilizes aluminum chloride as a catalyst.

4-Sulfonation involves substituting a sulfonic acid group (—SO3H) for a hydrogen atom in an aromatic hydrocarbon using concentrated or fuming sulfuric acid.

5-Nitration of benzene yields a single nitromethylbenzene isomer due to the nature of the benzene ring.

Aromatic hydrocarbons

Aromatic compound, any of a large class of unsaturated chemical compounds characterized by one or more planar rings of atoms joined by covalent bonds of two different kinds. Like Benzene.



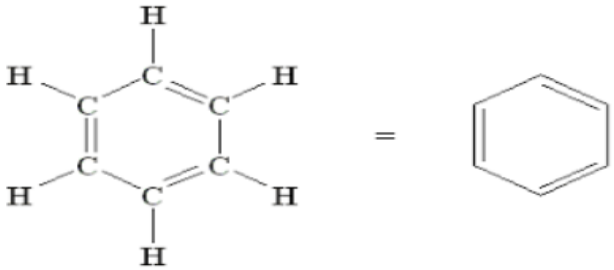
Physical Properties of Aromatic Compounds:

Aromatic compounds are generally nonpolar and immiscible with water. As they are often unreactive, they are useful as solvents for other nonpolar compounds. Due to their high ratio of carbon to hydrogen, aromatic compounds are characterized by a sooty yellow flame.

Nomenclature of aromatic hydrocarbons

All aromatic compounds are based on benzene, which has a ring of six carbon atoms and has the symbol: C_6H_6

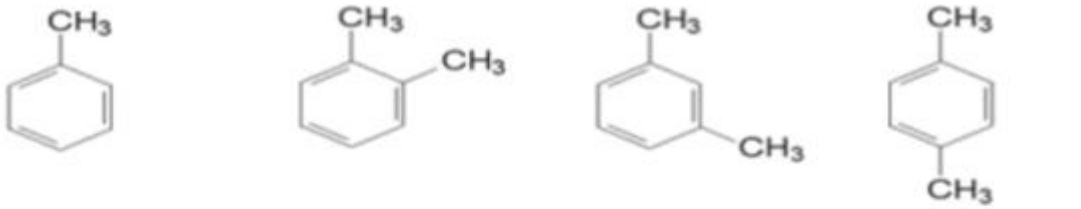
All C-C bond lengths are equal in this structure, whose symmetry is consistent with many studies showing that in benzene all carbon atoms are chemically equivalent.



Aromatic compounds with only one group attached to the benzene ring:

Chlorobenzene Bromobenzene Iodobenzene

Nitrobenzene Ethylbenzene



toluene
methylbenzene

ortho-xylene
1,2-dimethylbenzene

meta-xylene
1,3-dimethylbenzene

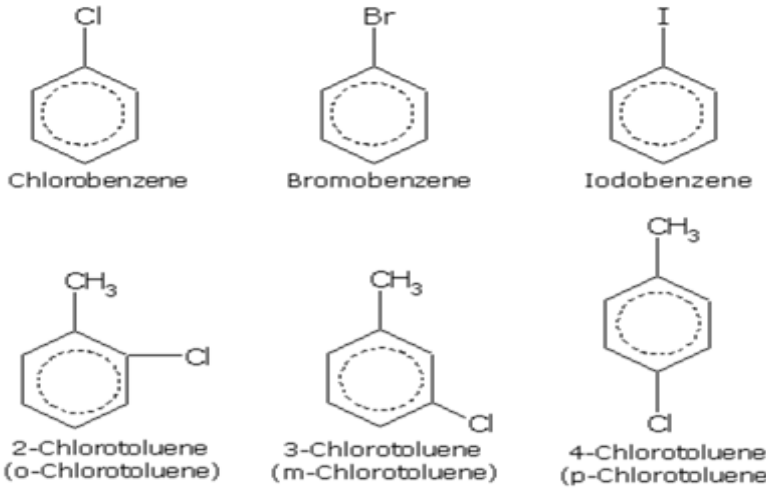
para-xylene
1,4-dimethylbenzene

aniline
aminobenzene

phenol
hydroxybenzene

benzaldehyde

benzoic acid



Chlorobenzene Bromobenzene Iodobenzene

2-Chlorotoluene
(o-Chlorotoluene)

3-Chlorotoluene
(m-Chlorotoluene)

4-Chlorotoluene
(p-Chlorotoluene

PROPERTIES OF BENZENE

1. Benzene is a colourless compound, and the physical state of benzene is liquid.

2. Benzene boils at 80.1^{o} C.

3. Benzene is not miscible in water and soluble in organic solvents.

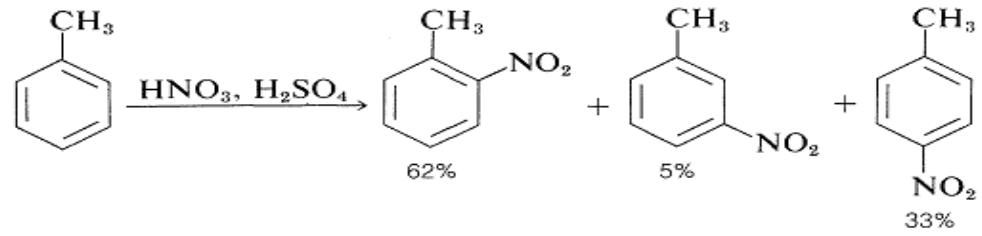
4. It has an aromatic odour.

5. The density of benzene is 0.87 gm/cm3 and is lighter than water.

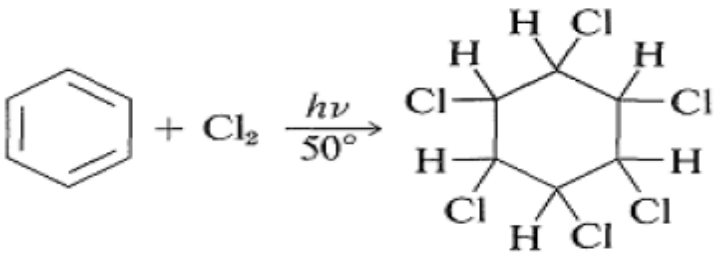
6. It is inflammable.

Electrophilic aromatic substitution

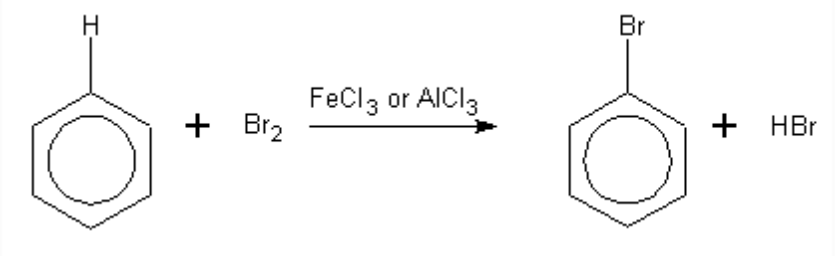
1. Nitration: The nitration of **methylbenzene (toluene)** is a typical example of a nitration that proceeds well using nitric acid in a 1: 2 mixture with sulfuric acid.The nitration product is a mixture of **2-, 3-, and 4-nitromethylbenzenes**:



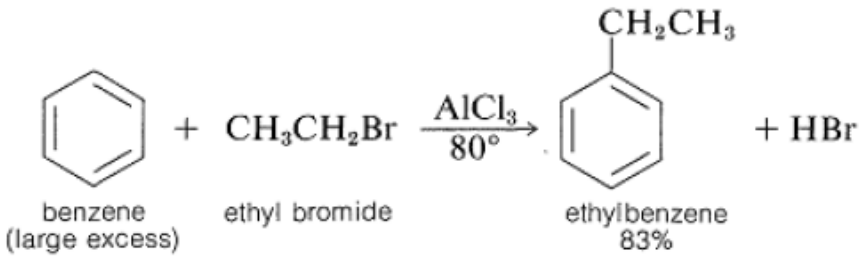
2. Halogenation: Benzene itself can be induced to add **halogens** on strong irradiation to give **polyhalocyclohexanes.**



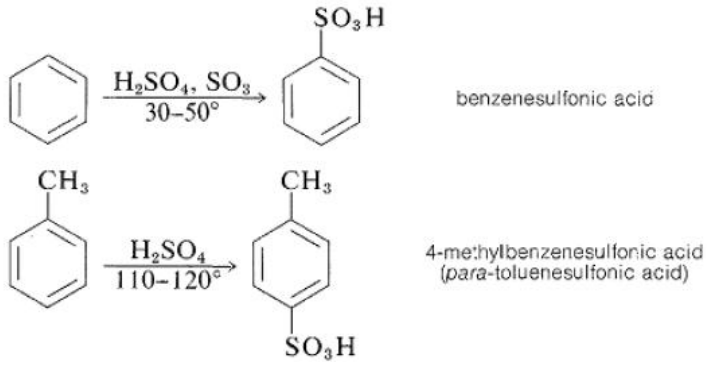
Light is excluded and with presence of Lewis acids (**$FeCl_3$, $AlCl_3$**).



3. Alkylation: An important method of synthesis of alkylbenzenes utilizes an alkyl halide as the alkylating agent and a metal halide, usually aluminum chloride, as catalyst**:**

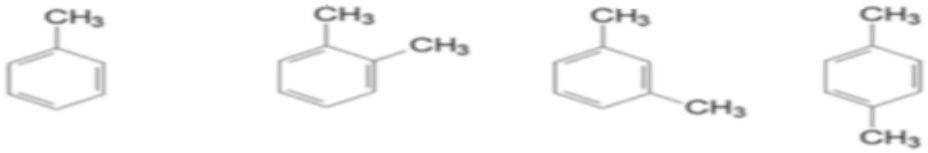


4. Sulfonation: Substitution of the **sulfonic acid (—SO_3H)** group for a hydrogen of an aromatic hydrocarbon can be carried out by heating the hydrocarbon with a slight excess of concentrated or **fuming sulfuric acid.**



Questions after the lecture **اسئلة البعدية**

Q1: Give the name of the following compounds



Q2: Enumerate Properties of Benzene

Q3 : What is the difference between the halogenation of benzene in the presence of light and the absence of light? Explain this with equations.

Q4: What is the purpose of the Friedel-Craft reaction? Explain this with the equations

Q5: Choose the correct answer for the following sentences:

1-How does benzene interact with water?

A. Highly soluble B. Completely miscible C. Insoluble

2- What is a notable sensory characteristic of benzene?

A. Odorless B. Sweet-smelling C. Aromatic odor

3- What is the density of benzene compared to water?

A. 1.00 gm/cm^3 B. 0.87 gm/cm^3 C. 0.95 gm/cm^3

4-Which reaction involves the substitution of a sulfonic acid group (—SO3H) for a hydrogen atom in an aromatic hydrocarbon?

A. Nitration B. Halogenation C. Sulfonation

5-What is the typical catalyst used in the alkylation of alkylbenzenes?

A. Nitric acid B. Sulfuric acid C. Aluminum chloride

6-Under what conditions does benzene undergo halogenation to form polyhalocyclohexanes?

A. Strong acid B. Strong base C. Strong irradiation

رقم المحاضرة: الثامنة	
عنوان المحاضرة:	Arenes (Structures, Nomenclature ,physical & chemical properties chemical reaction preparation methods.
اســـــم المدرس:	د. بركل سليمان مصطفى
الفئة المستهدفة :	المستوى الاول
الهدف العام من المحاضرة :	تعرف على تركيب ارينات وكيفية تسميتها وفقا لقواعد النظام الدولي وطرق تحضيرها .
الأهداف السلوكية او مخرجات التعلم:	1- التعرف على بنية وتسمية االارينات بشكل صحيح باستخدام نظام التسمية (IUPAC). 2- التعرف على طرق تحضير الارينات بمختلف الطرق الكيميائية 3- التعرف على الخصائص الفيزيائية للارينات مثل نقطة الغليان والكثافة ودرجة الذوبان وفهم تأثير البنية على الخصائص.
استراتيجيات التيسير المستخدمة :	1-ا ستخدام الرسوم البيانية والنماذج ثلاثية الأبعاد لتمثيل الهياكل الجزيئية للأرينات، مما يسهل فهم التوزيع الإلكتروني والترابط. 2- تقديم عروض مرئية تتضمن مقاطع فيديو أو صور توضيحية لخصائص الارينات واستخداماتها. 3- تشجيع العمل الجماعي في مشاريع صغيرة حول مواضيع مختلفة تتعلق بالأرينات، مما يعزز الفهم الجماعي والتواصل.
المهارات المكتسبة :	1-ا تقان قواعد التسمية للأرينات وفق نظام IUPAC والقدرة على تحديد الأسماء الشائعة. 2- القدرة على وصف وتطبيق طرق تحضير الأرينات المختلفة وفهم خطوات التفاعل.
طرق القياس المعتمدة:	استخدام اختبارات كتابية تتضمن أسئلة متنوعة مثل الأسئلة الاختيارية، والأسئلة الكتابية القصيرة، والأسئلة العملية التي تتطلب من الطلاب تطبيق المفاهيم على حل مشكلات كيميائية

Q1: Choose the correct answer for the following sentences:

1-What solvents are alkyl benzenes typically soluble in?

A. Water B. Polar solvents

C. Non-polar solvents like ether and carbon tetrachloride

2- How do the boiling points of alkyl benzenes change with increasing molecular weight?

A. They decrease B. They remain constant C. They increase

3-Which isomer of disubstituted benzenes generally has the highest melting point?

A. Meta (m-) B. Ortho (o-) C. Para (p-)

4- Which method is commonly used for the attachment of alkyl groups to benzene rings?

A. Friedel-Crafts alkylation B. Nitration C. Oxidation

5- Halogenation of toluene predominantly occur in the side chain Boiling toluene ----------.

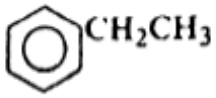
A. without any additional B. with bromine C. with chlorine and exposure to ultraviolet light

6- Which catalyst promotes the ring halogenation of alkylbenzenes?

A. Ultraviolet light B. Aluminum chloride C. Ferric chloride

Arenes

Aliphatic-aromatic hydrocarbons Many important compounds are not just aliphatic (alkane, alkene, or alkyne) or just aromatic (benzene) but contain both aliphatic and aromatic units; hydrocarbons of this kind are known collectively as arenes. Ethylhenzene, for example, contains a benzene ring and an aliphatic side chain.



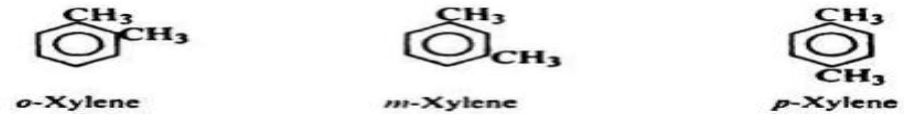
Ethylbenzene

Structure and nomenclature

The simplest of the alkylbenzenes, methylbenzene, is given the special name of toluene. Compounds containing longer side chains are named by prefixing the name of the alkyl group to the word -benzene, as, for example, in ethylbenzene, npropylbenzene, and isobutylbenzene.

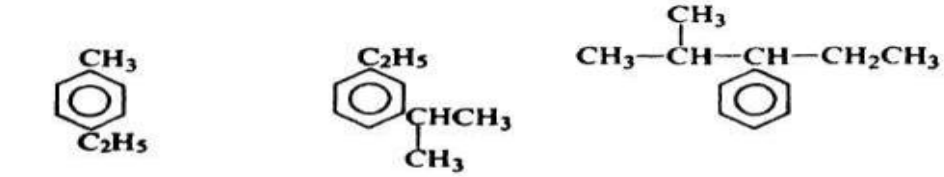
Toluene Ethylbenzene *n*-Propylbenzene Isobutylbenzene

The simplest of the dialkylbenzenes, the dimethylbenzenes, are given the special names of xylenes; we have, then, o-xylene, m-xylene, and p-xylene.



o-Xylene *m*-Xylene *p*-Xylene

Dialkylbenzenes containing one methyl group are named as derivatives of toluene, while others are named by prefixing the names of both alkyl groups to the word - benzene. A compound containing a very complicated side chain might be named as a phenylalkane (C_6H_5 = phenyl).



p-Ethyltoluene *m*-Ethylisopropylbenzene 2-Methyl-3-phenylpentane

Physical properties

As compounds of low polarity, the alkyl benzenes possess physical properties that are essentially the same as those of the hydrocarbons.

- They are insoluble in water, but quite soluble in non-polar solvents like ether, carbon tetrachloride, or ligroin. They are almost always less dense than water.

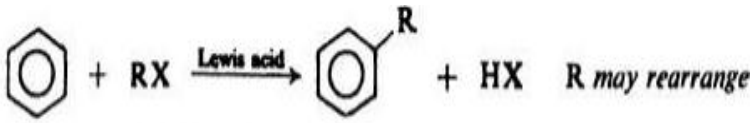
- Boiling points rise with increasing molecular weight, the boiling point increment being the usual 20-30˚for each carbon atom.

- Since melting points depend not only on molecular weight but also on molecular shape, their relationship to structure is a very complicated one. One important general relationship does exist, however, between melting point and structure of aromatic compounds: among isomeric disubstituted benzenes, the para isomer generally melts considerably higher than the other two.

Preparation of alkyl benzenes

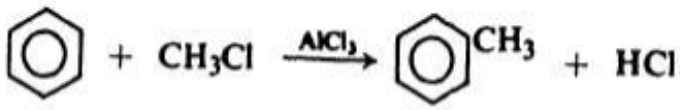
Although a number of the simpler alkylbenzenes are available from industrial sources, the more complicated compounds must be synthesized in one of this ways:

1. Attachment of alkyl group: Friedel-Crafts alkylation



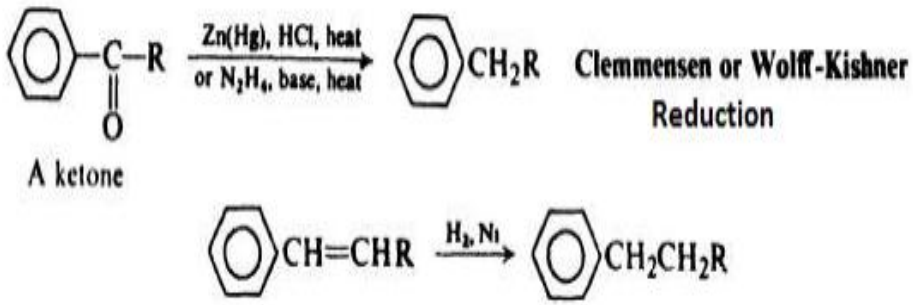
Lewis acid: $AlCl_3$, BF_3, HF, etc.
Ar-X *cannot be used in place of* R-X

If a small amount of anhydrous aluminum chloride is added to a mixture of benzene and methyl chloride, a vigorous reaction occurs, hydrogen chloride gas is evolved, and toluene can be isolated from the reaction mixture.



Toluene

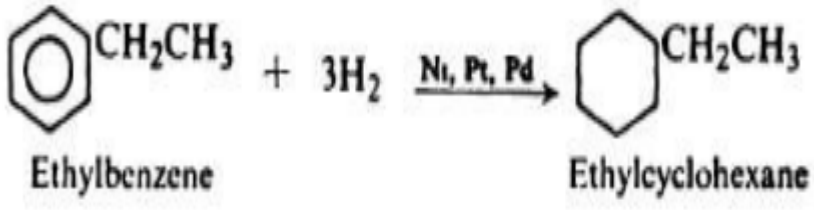
2. Conversion of side chain.



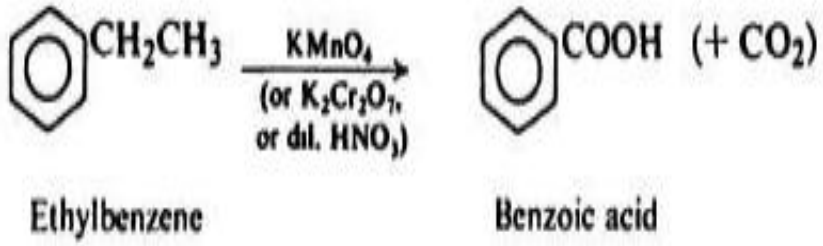
Reactions of alkyl benzenes

Except for hydrogenation and oxidation, The reactions of the alkylbenzenes are either electrophilic substitution in the aromatic ring or free-radical substitution in the aliphatic side chain. The experimental conditions determine which portion of the molecule aromatic or aliphatic is attacked, and each portion of the molecule modifies the reactions of the other portion.

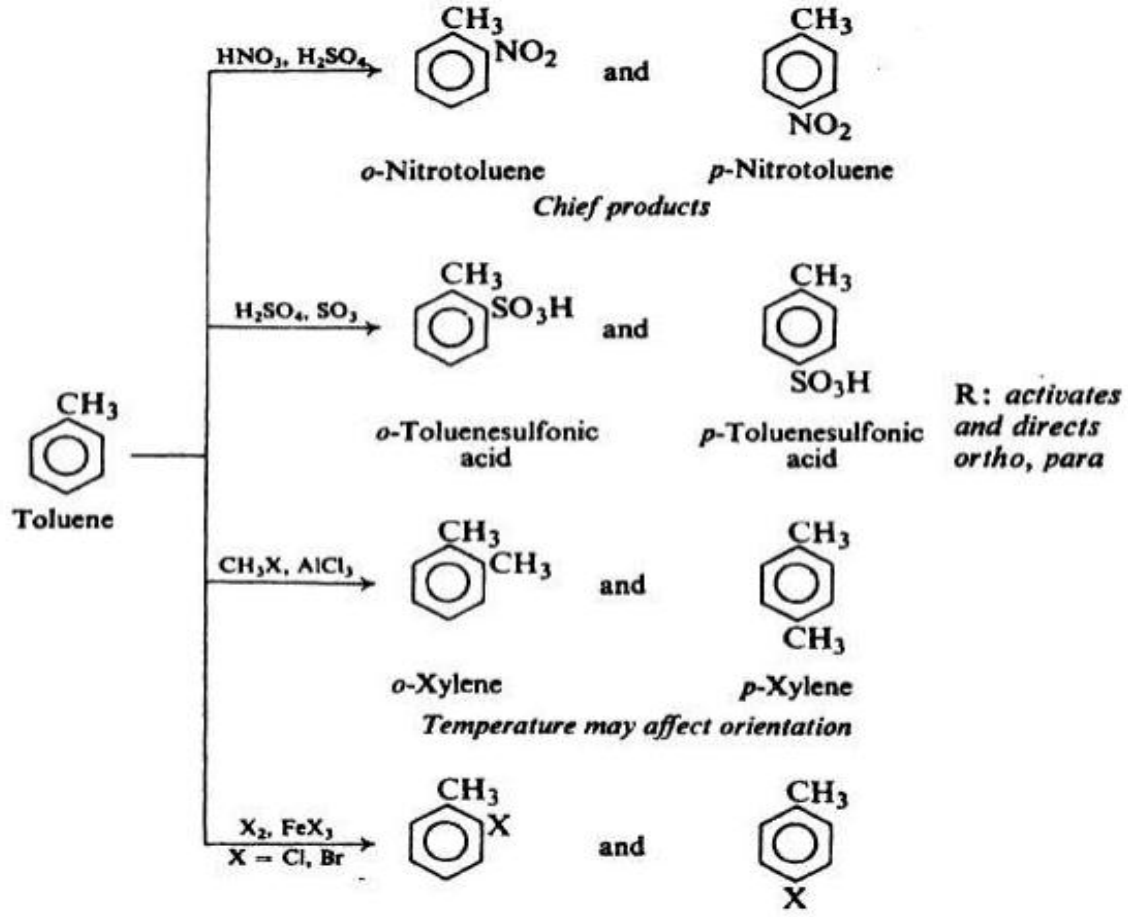
1. Hydrogenation.



2. Oxidation

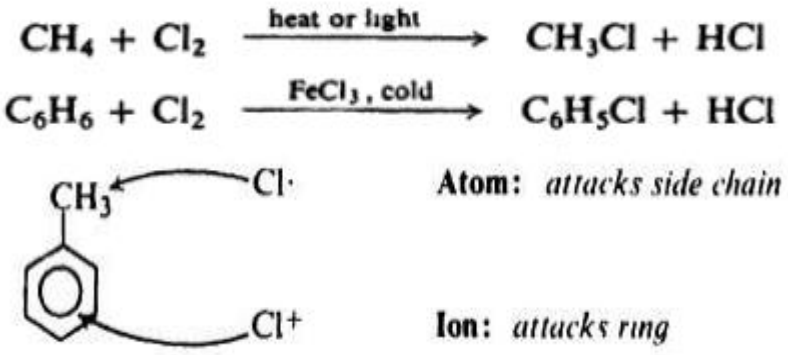


3. Substitution in the ring. Electrophilic aromatic substitution



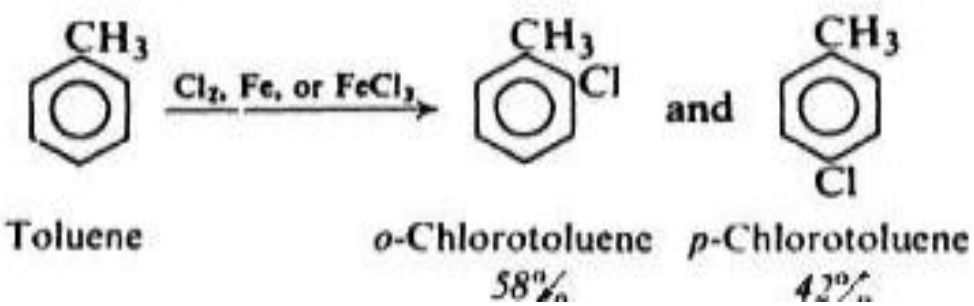
Halogenation of alkylbenzenes: ring vs. side chain

Alkylbenzenes clearly offer two main areas to attack by halogens: the ring and the side chain. We can control the position of attack simply by choosing the proper reaction conditions. Halogenation of alkanes requires conditions under which halogen atoms are formed, that is, high temperature or light. Halogenation of benzene, on the other hand, involves transfer of positive halogen, which is promoted by acid catalysts like ferric chloride



We might expect that the position of attack in toluene would be governed by which attacking particle is involved, and therefore by the conditions employed. If chlorine is bubbled into boiling toluene that is exposed to ultraviolet light, substitution occurs 12 almost exclusively in the side chain; in the absence of light and in the presence of ferric chloride, substitution occurs mostly in the ring.

Like nitration and sulfonation, ring halogenation yields chiefly the o- and p-isomers. Similar results are obtained with other alkylbenzenes, and with bromine as well as chlorine



Questions after the lecture **اسئلة البعدية**

Q1: Fill in the blanks to complete the meaning of the following sentences:

1-Arenes, also known as _____ hydrocarbons, contain both aliphatic and aromatic units in their structures.

2- The boiling points of alkyl benzenes increase with _____ molecular weight, typically rising by 20-30°C for each additional carbon atom

3- Friedel-Crafts alkylation is a method used for the attachment of _____ groups to benzene rings

4- Under conditions involving chlorine and ultraviolet light, halogenation of toluene primarily occurs in the _____ chain

5- _____ chloride acts as an acid catalyst promoting the ring halogenation of alkylbenzenes

Q2: Answer True or False of the following sentences:

1-Alkyl benzenes are typically soluble in water due to their low polarity.

2-The boiling points of alkyl benzenes decrease as the molecular weight increases.

3- Among isomeric disubstituted benzenes, the ortho (o-) isomer generally melts considerably higher than the para (p-) isomer.

4- Friedel-Crafts alkylation is a method used to attach alkyl groups to benzene rings.

5- Halogenation of toluene predominantly occurs in the ring when chlorine is bubbled into boiling toluene exposed to ultraviolet light.

6- Ferric chloride is an acid catalyst that promotes the ring halogenation of alkylbenzenes.

رقم المحاضرة: التاسعة والعاشرة	
عنوان المحاضرة:	Organic halogen compound(Alkyl halide) structure; Nomenclature; physical & chemical properties; preparation methods & uses; reaction
اســـم المدرس:	د. بركل سليمان مصطفى
الفئة المستهدفة :	المستوى الاول
الهدف العام من المحاضرة :	التعرف و فهم شامل لمركبات الهالوجين العضوية (الهاليدات الألكيلية) من حيث الهيكل، التسمية، الخصائص الفيزيائية والكيميائية، طرق التحضير، والاستخدامات
الأهداف السلوكية او مخرجات التعلم:	1- التعرف على بنية وتسمية للهاليدات الألكيلية ومكوناتها بشكل صحيح باستخدام نظام التسمية (IUPAC). 2- التعرف على التفاعلات الكيميائية الرئيسية للهاليدات الألكيلية مثل الاستبدال والإضافة. 3- التعرف على الخصائص الفيزيائية ألكاينات مثل نقطة الغليان والكثافة.
استراتيجيات التيسير المستخدمة	1 استخدام الرسوم البيانية والرسوم التوضيحية لشرح الهيكل والتفاعلات. 2- تقديم عروض مرئية تتضمن مقاطع فيديو أو صور توضيحية لخصائص هاليدات الكيل واستخداماتها. 3- تشجيع الطلاب على المشاركة في مناقشات حول الهاليدات الألكيلية وتفاعلاتها.
المهارات المكتسبة	1- اكتساب القدرة على تسمية هاليدات الكيل بشكل صحيح باستخدام النظام الدولي للتسمية، مما يعزز الفهم الدقيق لتركيب 2- القدرة على تحليل وفهم الهياكل الكيميائية للهاليدات الألكيلية. 3- القدرة على شرح وفهم التفاعلات الكيميائية المختلفة للهاليدات الألكيلية.
طرق القياس المعتمدة	استخدام اختبارات كتابية تتضمن أسئلة متنوعة مثل الأسئلة الاختيارية، والأسئلة الكتابية القصيرة، والأسئلة العملية التي تتطلب من الطلاب تطبيق المفاهيم على حل مشكلات كيميائية

Q1: Choose the correct answer for the following sentences:

1- Alkyl halides are compounds in which one or more hydrogen atoms in an alkane have been replaced by ---------atoms.

A- Cl, Br B- He,F C- Na,Cl

2- The carbon and halogen in compound Alkyl halide always share a ----- bond.

A- Single B- Double C- Triple

3- In ------- alkyl halides the carbon bonded to the halogen atom is only attached to one other alkyl group.

A- Primary B- Secondary C- Tertiary

4- In ------- alkyl halides the carbon bonded with the halogen atom is joined directly to two other alkyl groups.

A- Primary B- Secondary C- Tertiary

5- In a primary haloalkane, the carbon bonded to the halogen atom is only attached to ----- other alkyl group.

A-one B- two C- three

6- Why are alkyl halides insoluble in water despite their polarity?

A. They lack hydrogen atoms B. They are non-polar
C. The attraction between alkyl halide molecules is stronger than between alkyl halide and water molecules

7- Which halogen compound is typically the most dense and has the highest boiling point?

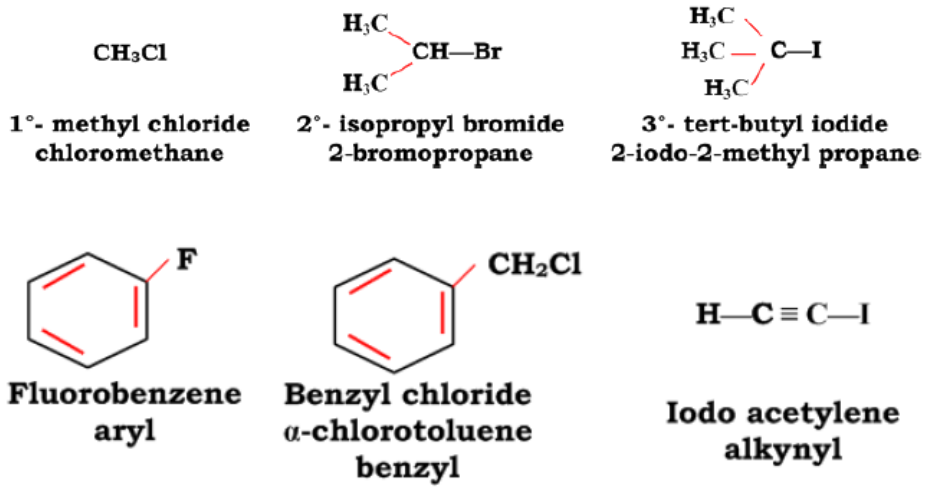
A. Fluoro compounds B. Chloro compounds C.Iodo compounds

8-What factor contributes to the increasing boiling point order among alkyl halides (F < Cl < Br < I)?

A. Molecular weight B. Number of carbon atoms
C. Degree of halogenation

Organic halogen compound

Compounds containing halogen atoms , **F , Cl , Br , I** are classified as **1° , 2° , 3°** alkyl , benzyl , or alkynyl depending upon the organic group to which the halogen is attached . Halogen atoms are considered substituent , not functional groups , in naming organic compounds.



Applications

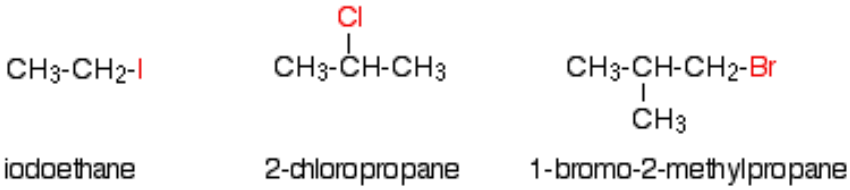
Both carbon tetrachloride **CCl4** and **trichloroethylene CHCl = CCl2** are used in the dry cleaning industry fats, greases are soluble in these nonpolar solvents. Carbon tetrachloride is also used in fire extinguishers but may generate phosgene **COCl2** an extremely toxic gas , if used in conjunction with water.

$$CCl_4 + H_2O \xrightarrow{\Delta} COCl_2 + 2HCl$$

Ethyl chloride, CH_3CH_2Cl is used as a local anesthetic. Chloroform $CHCl_3$ has been used as an anesthetic but is extremely toxic. Iodoform CHI_3 is used as an antiseptic and has a characteristic odor

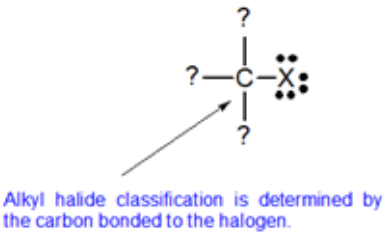
Alkyl halides

Alkyl halides are also known as haloalkanes. Alkyl halides are compounds in which one or more hydrogen atoms in an alkane have been replaced by halogen atoms (fluorine, chlorine, bromine or iodine).



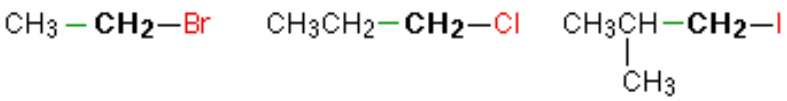
Classified of Alkyl halides

Alkyl halides fall into different classes depending on how the halogen atom is positioned on the chain of carbon atoms. Alkyl halides can be classified as primary, secondary, or tertiary. The carbon and halogen always share a single bond. Alkyl halide classification is determined by the bonding pattern of the carbon atom bonded to the halogen as shown in the diagram below.



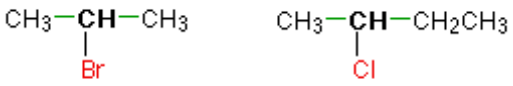
1-Primary alkyl halides

In a primary (1°) haloalkane, the carbon bonded to the halogen atom is only attached to one other alkyl group. Some examples of primary alkyl halides include thecompounds below.



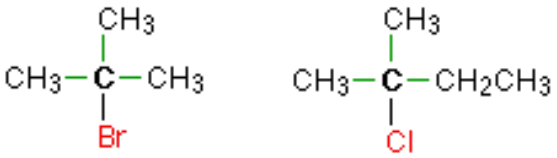
2-Secondary alkyl halides:

In a secondary (2°) haloalkane, the carbon bonded with the halogen atom is joined directly to two other alkyl groups that can be the same or different. Some examples of secondary alkyl halides include thecompounds below.



3-Tertiary alkyl halides:

In a tertiary (3°) halogenoalkane, the carbon atom holding the halogen is attached directly to three alkyl groups, which may be any combination of same or different. Some examples of tertiary alkyl halides include thecompounds below.



Nomenclature:

Nomenclature According to IUPAC, alkyl halides are treated as alkanes with a halogen (Halo-) substituent. The halogen prefixes are Fluoro-, Chloro-, Bromo- and Iodo-. Examples:

CH_3CH_2 Cl	CH_3CH_2 F	$CH_3CH_2CH_2CH_2Cl$
Chloroethane	Fluoroethane	1-chlorobutane

Physical properties:

1- Alkyl halides have higher boiling point than alkane of the number of carbon because the greater M.wt., Also iodide compound have higher b.p than Br > Cl > F

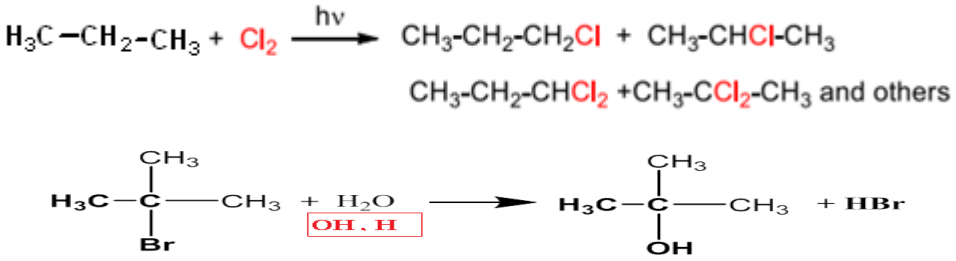
2- Alkyl halides insoluble in water in spite of their polarity soluble in most organic solvent. The attraction between the alkyl halide molecules is stronger than the attraction between the alkyl halide and water. Iodo , bromo, poly chloro compound are more dense than water .

Preparation of Alkyl Halides :

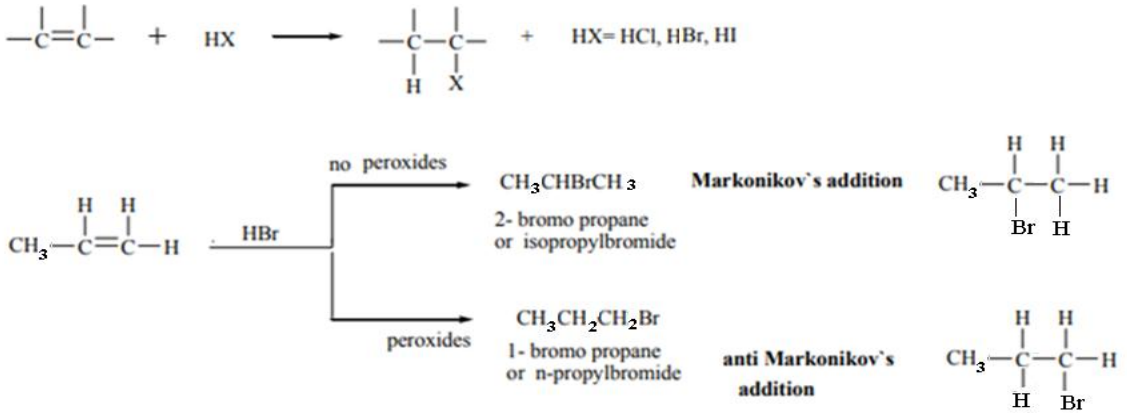
Numerous ways to make alkyl halides.

1- Halogenation

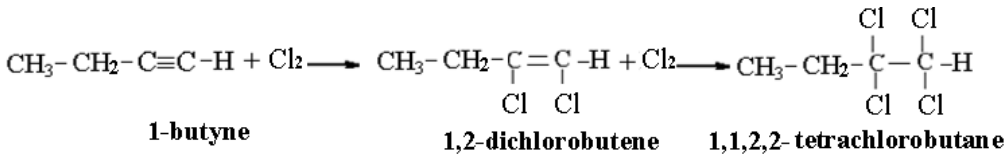
Free Radical **Halogenation** Usually this method gives mixtures of mono-, di- , tri- etc halogenated compounds, which is considered an inefficient method for the synthesis of a desired compound. Consider propane:



2- Addition of hydrogen halide to alkenes and alkynes:



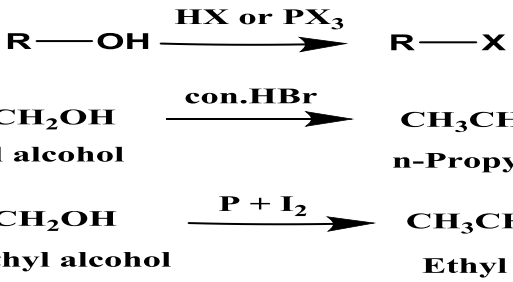
3- Addition of halogens to alkenes and alkynes:



4- Addition of hydrogen halide to alcohol

Reaction alcohol with hydrogen halide some time the reaction require catalyst

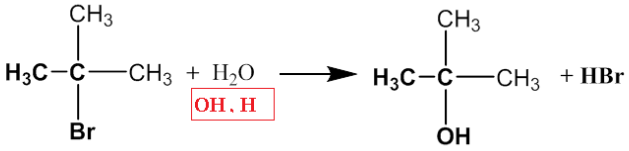
for least reactive hydrogen halide with 1° and 2° alcohol:



Reactions of Alkyl Halides:

1-Nucleophilic substitution

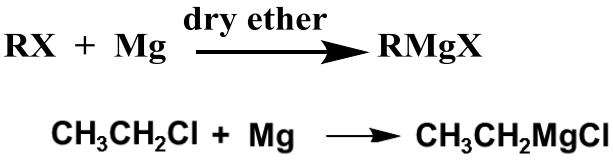
Halide ion is weak base, so readily displaced by other stronger bases



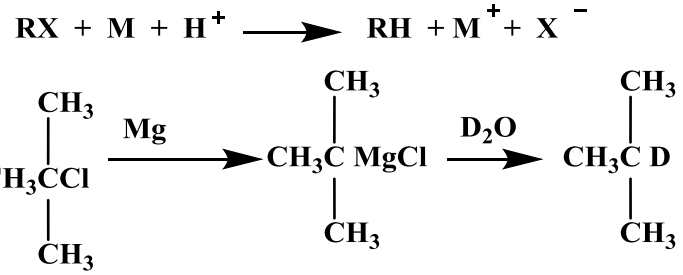
2- Elimination reaction:

Secondary and tertiary alkyl halides prefer elimination reactions with hot bases, and the alkyl halide HX molecule is removed from two adjacent carbons, producing the alkene.

3- Preparation of Grignard reagents:



4- Reduction : اختزال



Alkyl halide uses in pharmacy

Alkyl halides have several important uses in the pharmaceutical industry, including:

1. Synthesis of Drugs: Alkyl halides serve as key intermediates in the synthesis of various pharmaceuticals. They can be used in nucleophilic substitution reactions to introduce alkyl groups into drug molecules.
2. Antimicrobial Agents: Some alkyl halides have antimicrobial properties and are used in the development of antiseptics and disinfectants.
3. Anesthetic Agents: Certain alkyl halides are utilized in the formulation of inhalation anesthetics due to their volatility and pharmacological effects.
4. Chemical Probes: Alkyl halides can be used as chemical probes in research to study biological processes and molecular interactions.
5. Solvents and Reagents: They are often used as solvents or reagents in laboratory synthesis and medicinal chemistry.

Overall, their reactivity and ability to modify molecular structures make alkyl halides valuable in drug development and research.

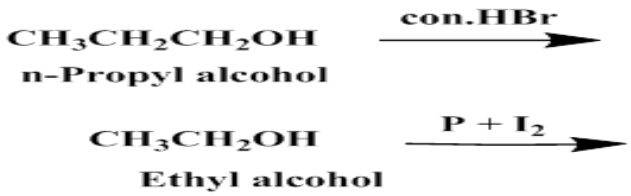
Questions after the lecture **اسئلة البعدية**

Q1: Starting from 1-butyne, prepare (1-butene and 1 -bromobutane)

Q2: Starting from 1-butyne, prepare (1- butene and 2-bromobutane)

Q3: What is the difference between Nucleophilic substitution and the Elimination reaction of the alkyl halides, support your answer with examples

Q4:Complete the following equations:



Q5: Choose the correct answer of the following sentences

1- In a secondary haloalkane, the carbon bonded with the halogen atom is joined directly to ------other alkyl groups

A-One B-Two C- Three

2- Secondary and tertiary alkyl halides prefer ----------reactions with hot bases.

A- Elimination B-Substitution C- Exchange

3- Alkyl halides have higher boiling point than alkane of the number of carbon because the greater ------.

A-Molecular weight B- Volume C-Weight

4- Alkyl halides insoluble in ----------in spite of their polarity soluble in most organic solvent.

A- Water B- Ethanol C- Methanol

5-Halides generally have higher boiling points compared to alkanes of the same number of carbon atoms?

A. They have a lower molecular weight B. They are less polar
C. They have stronger intermolecular forces due to dipole-dipole interactions

رقم المحاضرة: الحادي والثاني عشر	
عنوان المحاضرة:	Alcohol; structure& nomenclature; preparation reaction uses in pharmacy.
اســـــم المدرس:	د. بركل سليمان مصطفى
الفئة المستهدفة :	المستوى الاول
الهدف العام من المحاضرة :	تعرف وفهم شامل لمركبات الكحول، بما في ذلك هيكلها، تسميتها، طرق التحضير، التفاعلات، واستخداماتها في مجال الصيدلة.
الأهداف السلوكية او مخرجات التعلم:	1- التعرف على التركيب الجزيئي للكحول وفهم طبيعة المجموعة الوظيفية (OH). 2- إتقان قواعد التسمية وفقًا لمبادئ IUPAC للكحوليات المختلفة. 3- معرفة الطرق المختلفة لتحضير الكحول، مثل الهدرجة وأكسدة الألكينات.
استراتيجيات التيسير المستخدمة	1- تقديم رسوم بيانية أو مخططات توضح الهيكل الجزيئي للكحوليات وتركيبها. 2- تقديم عروض مرئية تتضمن مقاطع فيديو أو صور توضيحية لخصائص الكحولات واستخداماتها. 3- تقسيم الطلاب إلى مجموعات صغيرة لمناقشة موضوعات معينة وتبادل المعرفة.
المهارات المكتسبة	1- اكتساب القدرة على تسمية الكحولات بشكل صحيح باستخدام النظام الدولي للتسمية، مما يعزز الفهم الدقيق لتركيب 2- فهم دور الكحول في الصناعات الدوائية وكيفية استخدامه في التركيبات الدوائية. 3 -القدرة على تفسير التفاعلات الأساسية للكحول، مثل الأكسدة والتفاعلات مع الأحماض.
طرق القياس المعتمدة	استخدام اختبارات كتابية تتضمن أسئلة متنوعة مثل الأسئلة الاختيارية، والأسئلة الكتابية القصيرة، والأسئلة العملية التي تتطلب من الطلاب تطبيق المفاهيم على حل مشكلات كيميائية

Q1: Choose the correct answer for the following sentences

1- Alcohols are compounds of general formula--------- .

a- R-OH b- R=OH c- R-O2H

2- In ------- Alcohols have one carbon atom directly attached to the carbinol carbon.

a- Primary b- Secondary c- Tertiary

3- In ------- Alcohols have two carbon atom directly attached to the carbinol carbon.

a- Primary b- Secondary c- Tertiary

4- In a primary Alcohols, the OH directly attached to the carbinol carbon with ------ alkyl group.

a-one b- two c- three

5- In a secondary Alcohols, the OH directly attached to the carbinol carbon with -- alkyl group.

a-one b- two c- three

6- Alcohols posses high boiling points due to ---------- bonding.

a- hydrogen b-ionic c-coordinate

7- The boiling points in Alcohols increases with increasing ------ .

a-Molecular weight b- Volume c-Weight

8- The first three primary alcohols (C_1-C_3)are miscible with ------ ,because of their ability to form hydrogen bonds.

a- Water b- Ethanol c- Methanol

9- The first three primary alcohols (C_1-C_3)are ------- with water ,

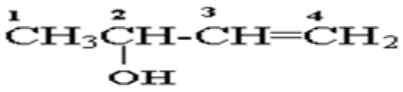
a- miscible b- non miscible c- in soluble

10-Alcohols are compounds of general formula--------- .

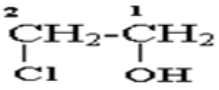
a- $C_nH_{2n+1}O$ b- $C_nH_{2n}O$ c- $C_nH_{2n-2}O$

Alcohols ($C_nH_{2n+2}O$)

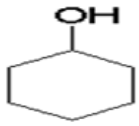
Alcohols are compounds of general formula R-OH ,where R is alkyl or substiuted alkyl group , R may be 1^o,2^o ,3^o alochols .It may be open chain or cyclic , it may contain adouble bond ,a halogen atom or any aromatic ring .



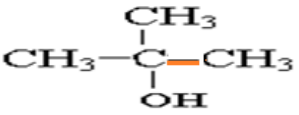
3-butene-2-ol



2- chloro ethanol



Cyclohexanol

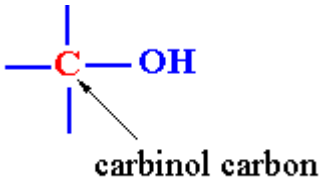


2-methyl -2-propanol

Classification of Alcohols :

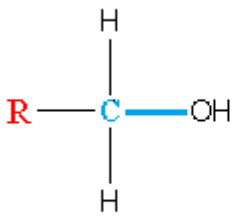
Alcohol are classified into three different types depending on the nuber of carbon atoms that are attached to the carbinol carbon (or alcoholic).

The carbinol carbon is the carbon that holds the – OH group.

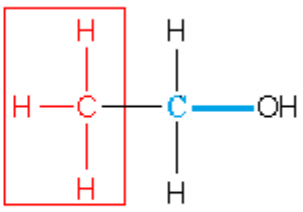


carbinol carbon

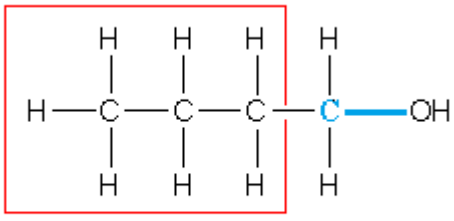
1- **Aprimary alcohols (1^o)** have **one carbon atom** directly attached to the carbinol carbon .The general formula for primary 1^o alcohols is :



primary 1^o alcohols

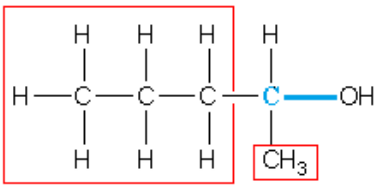


ethanol



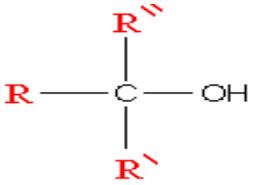
1-butanol

2-Secondary alcohols (2^o) have **two carbon atom** directly bonded to the carbinol carbon **:**

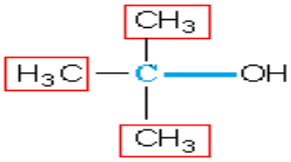


2-pentanol

3- Tertiaary alcohols (3^{o}) have **threecarbon atom** directly attached to the carbinol carbon :



where R ,R',and R" = C groups

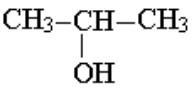


Nomenclature :

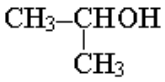
For the simpler alcohols the common names are most often used .These consist simply othe name of the alkyl group followed by the word alcohol.

ex : CH_3CH_2OH

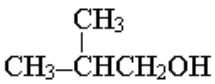
ethyl alcohol



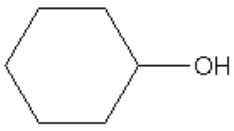
Isopropyl alcohol



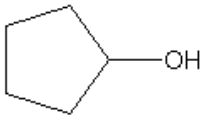
Isopropyl alcohol
or isopropanol



Isobutyl alcohol
or isobutanol



cyclo hexyl alcohol



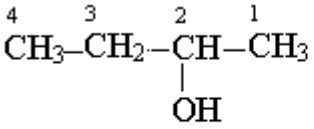
cyclo pentyl alcohol

This method can be used only used only for simple alcohols .

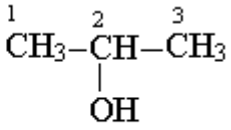
more complex alcohols are named accord to IUPAC rules.These rules are :

1-Select the longest continuous carbon chain that contains the - OH group ,the ending "-e " of the name of the parent alkane ,alkene ,or alkyne is

replaced by "-Ol".The position of the hydroxyl group,side chains,are indicated by the lowest possible arabic numerals:

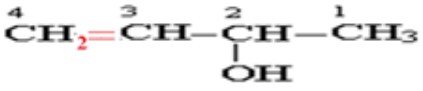


2- butanol



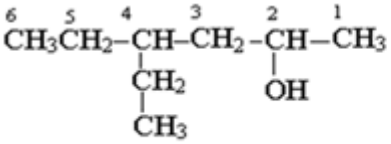
2- propanol

A main functional group of alcohols ,the hydroxyl group takes preference in getting the lower numbers double or triple bonds :

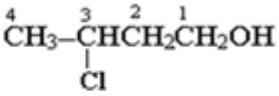


3-butene-2-ol

2- when another substituent is present specify its position on the chain by a number and name the substituent .The position of the (-OH)group is always at the end of the names :

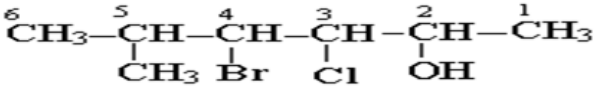


4-ethyl-2-hexanol



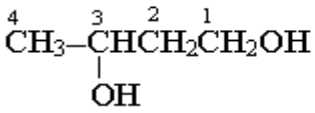
3-chloro-1-pentanol

3- If several substituents are present ,follow rule (2) and list the susbstituents alphabetically :

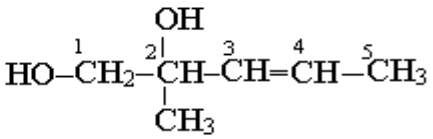


4-bromo-3-chloro-5-methyl-2-hexanol

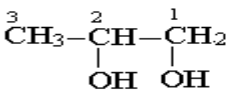
4- When two or three hydroxyl groups are present ,the suffix "-diol" or "triol" is added to the name of the parent alkane , alkene or alkyne :



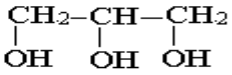
1,3- butane diol



2-methyl-3-pentene-1,2-diol



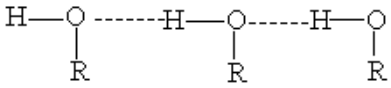
1,2-propanediol



1,2,3-propanetriol

Physical properties of alcohols:

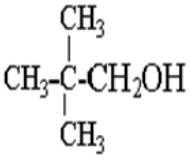
1- Alcohols posses high boiling points due to hydrogen bonding.



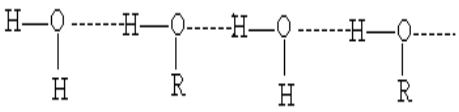
- The boiling points increases with increasing carbon number (M.Wt).

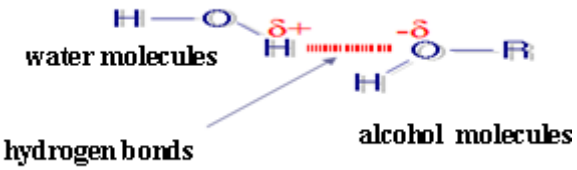
$CH_3CH_2OH > CH_3OH$

- branching decrease the boiling points of alchols .

b.p $CH_3CH_2CH_2CH_2CH_2OH$ **>b.p** 

2- The first three primary **alcohol**s (C_1-C_3)are miscible with water ,because of their ability to form **hydrogen bonds** with the **water molecules** .

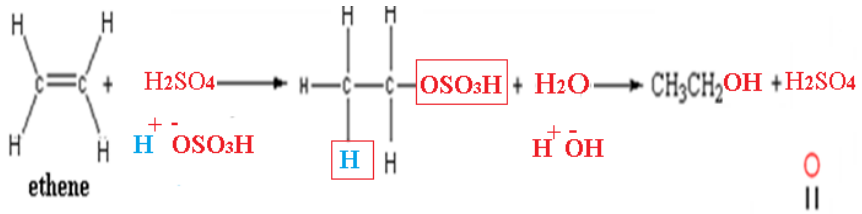




Preparation of Alcohols :

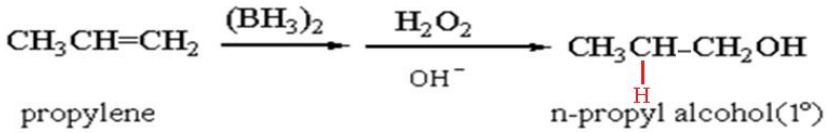
1- Hydration of Alkenes :

Addition of sulphuric acid to an alkene and subseguent decomposition of the addition product with steam :

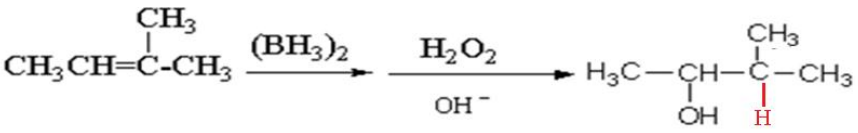


2- Hydroboration :

Addition of diborane to an alkene (hydroboration)followed by oxidation of the addition product with hydrogen peroxide :



propylene n-propyl alcohol(1°)

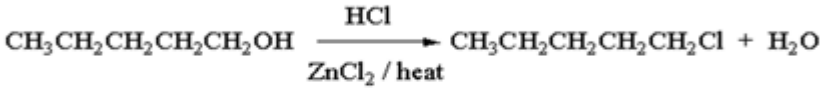


2-methyl-2-butene 3-methyl-2-butanol (2°)

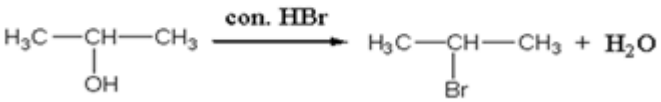
Reactions of alcohols :

1- Reactions with hydrogen halides :

Examples :



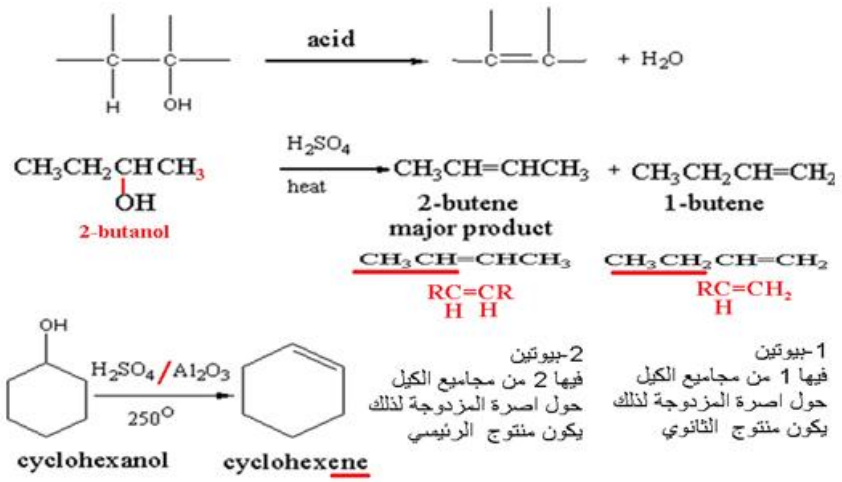
n-pentyl alcohol **n-pentyl chloride**



Iso-propyl alcohol **Iso- propyl bromide**

2- Dehydration:

In this reaction ,a molecule of water is eliminated from an alcohol molecule by heating the alcohol in the presence of a strong mineral acid , A double bond forms between the adjacent carbon atoms that lost the hydrogen ion and hydroxide group



Alcohols usea in pharmacy

Alcohols, which are organic compounds characterized by the presence of a hydroxyl (-OH) group attached to a carbon atom, have diverse uses in pharmacy. Some of the key applications include:

1. **Antiseptics and Disinfectants**: Alcohols such as ethanol (ethyl alcohol) and isopropyl alcohol (isopropanol) are widely used as antiseptics and disinfectants. They are effective against a broad spectrum of microorganisms and are commonly used to sterilize surfaces, medical instruments, and skin before injections or surgeries.
2. **Solvents**: Alcohols serve as versatile solvents in pharmaceutical formulations. Ethanol, for example, is used to dissolve active ingredients and other components in liquid formulations such as syrups, elixirs, and oral solutions. Isopropyl alcohol is also used as a solvent in certain formulations and for cleaning purposes in pharmaceutical facilities.
3. **Cosolvents**: Alcohols are often used as solvents in injectable formulations to improve solubility of drugs that are poorly soluble in water. They can help enhance the bioavailability of drugs and ensure uniform distribution of active ingredients.
4. **Preservatives**: Certain alcohols, such as benzyl alcohol and phenylethyl alcohol, are used as preservatives in pharmaceutical preparations. They

help prevent microbial growth and extend the shelf life of multi-dose formulations like nasal sprays and topical solutions.

5. **Tinctures and Extracts**: Alcoholic solutions (tinctures) are commonly used to extract and preserve active compounds from medicinal plants. These tinctures are used in herbal medicine and homeopathy.
6. **Excipients**: Alcohols like glycerol (glycerin) and propylene glycol are used as excipients in various pharmaceutical formulations. Glycerin is a common component in ointments, creams, and suppositories due to its moisturizing and emollient properties. Propylene glycol is used as a solvent, humectant, and stabilizer in oral, topical, and injectable formulations.
7. **Denaturants**:Ethanol is sometimes used as a denaturant in pharmaceutical preparations to render them unfit for consumption, especially in products like rubbing alcohol or certain topical solutions.

These applications demonstrate the importance of alcohols in pharmaceutical science, where they contribute significantly to formulation stability, efficacy, and safety.

Questions after the lecture **اسئلة البعدية**

Q1: Enumerate of method to prepare alcohols, giving an example for each method

Q2: Enumerate of types of alcohols, giving an example for each

Q3: Fill in the blanks to complete the meaning of the following sentences:

1-Alcohols possess high boiling points due to _____ bonding

2-The boiling points of alcohols increase with increasing _____.

3-Branching in alcohols tends to _____ the boiling points.

4-_____ of alkenes involves addition of sulfuric acid followed by decomposition of the addition product with steam.

5-_____ is a process where diborane is added to an alkene followed by oxidation of the addition product with hydrogen peroxide.

6-In the dehydration of alcohols, a molecule of water is eliminated to form _____ between the adjacent carbon atoms.

7-The first three primary alcohols (C1-C3) are miscible with water due to their ability to form _____ with the water molecules.

Q4: Answer True or False of the following sentences:

1-Alcohols have low boiling points because they lack intermolecular forces.

2-Branching in alcohols increases their boiling points.

3-Hydration of alkenes involves the addition of water to form alcohols.

4-Hydroboration is a process where alcohols are converted to alkenes by removing water.

5-Dehydration of alcohols results in the formation of a double bond between adjacent carbon atoms.

6-Primary alcohols (C1-C3) are generally soluble in water due to their ability to form hydrogen bonds with water molecules.

رقم المحاضرة: الثالث و الرابع والخامس عشر	
عنوان المحاضرة:	Phenol structure& nomenclature; preparation reaction uses in pharmacy
اســـــم المدرس:	د. بركل سليمان مصطفى
الفئة المستهدفة :	المستوى الاول
الهدف العام من المحاضرة :	تعرف و فهم شامل لمركب الفينول، بما في ذلك هيكله، تسميته، طرق تحضيره، تفاعلاته، واستخداماته في مجال الصيدلة. الهدف هو تعزيز المعرفة العلمية حول الفينولات وتطبيقاتها العملية في الصناعة الدوائية.
الأهداف السلوكية او مخرجات التعلم:	1- التعرف على بنية وتسمية الفينولات بشكل صحيح باستخدام نظام التسمية (IUPAC). 2- التعرف على التركيب الجزيئي للفينول وفهم طبيعة المجموعة الوظيفية (OH) المرتبطة بحلقة بنزين. 3- معرفة الطرق المختلفة لتحضير الفينول وفهم العمليات الكيميائية المعنية.
استراتيجيات التيسير المستخدمة	1- استخدام الرسوم التوضيحية، الشرائح التقديمية، ومقاطع الفيديو لتوضيح الهيكل والتفاعلات. 2- عرض أمثلة حقيقية عن استخدامات الفينول في الصناعة الدوائية لتحفيز التفكير النقدي. 3- تقسيم الطلاب إلى مجموعات لمناقشة مواضيع معينة وتبادل المعرفة والخبرات.
المهارات المكتسبة	1- اكتساب القدرة على تسمية الفينولات بشكل صحيح باستخدام النظام الدولي للتسمية، مما يعزز الفهم الدقيق لتركيب 2- معرفة طرق تحضير الفينول وفهم العمليات الكيميائية المرتبطة بها. 3- القدرة على تفسير التفاعلات الأساسية للفينول، مثل الاستبدال والأكسدة.
طرق القياس المعتمدة	استخدام اختبارات كتابية تتضمن أسئلة متنوعة مثل الأسئلة الاختيارية، والأسئلة الكتابية القصيرة، والأسئلة العملية التي تتطلب من الطلاب تطبيق المفاهيم على حل مشكلات كيميائية

Q1: Choose the correct answer for the following sentences

1-General formula for phenol is ----------.

A- C_6H_6O B- C_6H_6OH C- C_5H_6O

2 -The ------- acid is another name for a phenol compound

A-Carbolic B- picric C- Carbonic

3- Phenol is produced synthetically industrially from a compound----------.

A-Chlorobenzene B- Cumene C- Benzene

4- Phenol reacts with dilute nitric acid at low temperatures to give a mixture of ---------- form.

A- meta and para B- ortho and para C- ortho and meta

5- Phenol reacts with concentrated nitric acid to produce ----------acid.

A- picric B-Carbolic C-Carbonic

6-Phenol reacts with concentrated sulfuric acid to give an ortho-form at ------ temperatures

A- low B- high c- middle

7-Phenol reacts with concentrated sulfuric acid to give a para-form at ----- temperatures

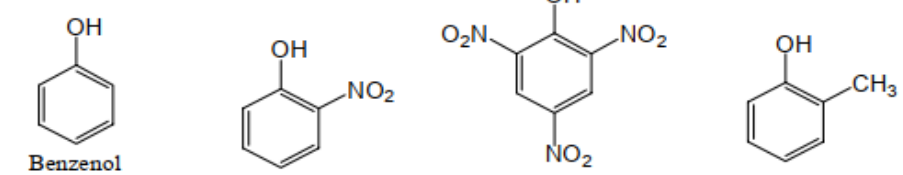
A- low B- high c- middle

Phenols

Organic compounds whose molecules are characterized by the presence of a hydroxyl group attached directly to a benzene ring,It is considered hydroxylated derivatives of aromatic hydrocarbons

Nomenclature:

Phenols are named as derivatives of the phenol compound, following the rules for naming benzene, Examples



Benzenol
Phenol
[Carbolic acid]

2-Nitro phenol
[o-Nitro phenol]

2,4,6-Trinitro phenol
[Picric acid]

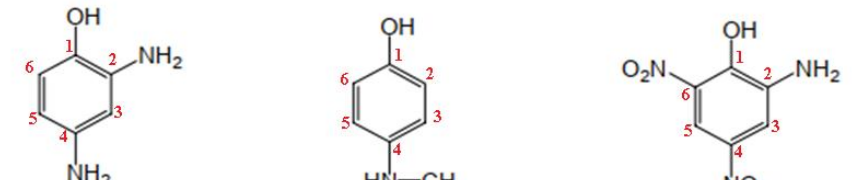
2-Methyl phenol
[o-Cresol]

Classification of Phenols

Phenols are classified according to the number of hydroxyl groups into:

1- Monohydroxy phenols

They are phenols that contain only one hydroxyl group, such as:



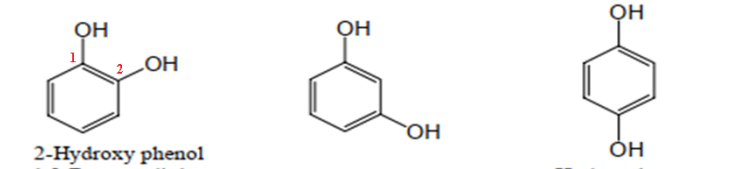
2,4-Diamino phenol

4-(*N*-Methyl amino) phenol

2-Amino-4,6-dinitro phenol

2- Dihydroxyl phenols

Its molecules contain two hydroxyl groups such as

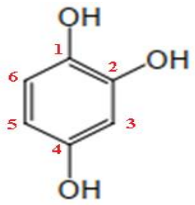


2-Hydroxy phenol
or 1,2-Benzenediol
[Catechol]
كاتيكول بنزين ديول

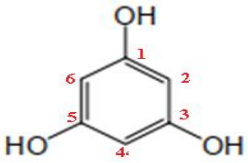
[Resorcinol]
الريزورسينول

Hydroquinone
[**or** Quinol]
الهيدروكوينون كينول

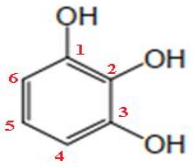
3-Trihydroxyl phenols



1,2,4-Trihydroxy benzene



1,3,5-Trihydroxy benzene

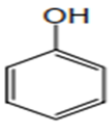


1,2,3-Trihydroxy benzene

Physical properties of phenols

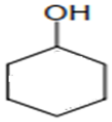
1-Boiling point

Phenols have **high boiling points** due to their ability to form hydrogen bonds between their molecules, and compared to the alcohols corresponding to them in molecular weight, we find that the boiling points of phenols are higher due to the phenyl ring, which withdraws electrons, which increases the polarization of the OH bond in the hydroxyl group, so hydrogen bonds are stronger than those formed by alcohols An example of this is phenol and cyclohexanol, which have boiling points of 182^{o}C and 161.5^{o}C, respectively.



Phenol

م° 182

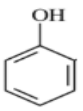


Cyclohexanal

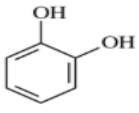
م ° 161.8

2- Solubility :

Phenols have low solubility in water because their carbon structure contains at least six carbon atoms. The solubility of phenols increases by increasing the hydroxyl groups on the ring. The solubility of phenol is: 9.3 g/100ml H_2O and the solubility of catechol: 45
g/100ml H_2O



Phenol

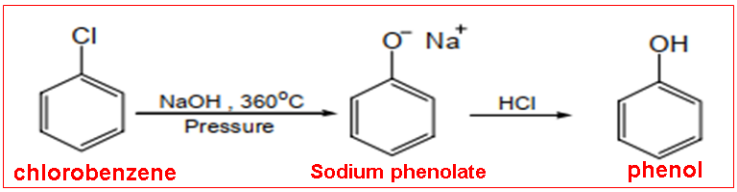


Catechol

Preparation of phenol

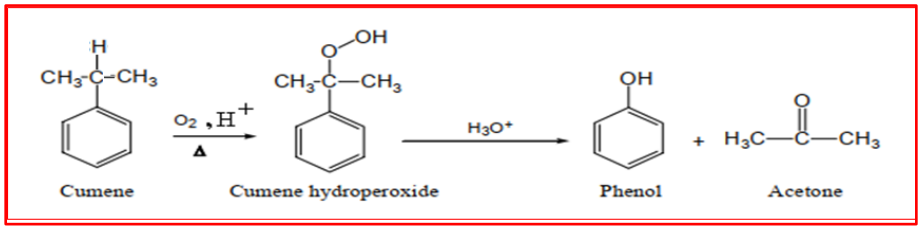
1- Addition of sodium hydroxide to Chlorobenzene

Phenol is prepared **industrially** from chlorobenzene according to the following **Dow process:**



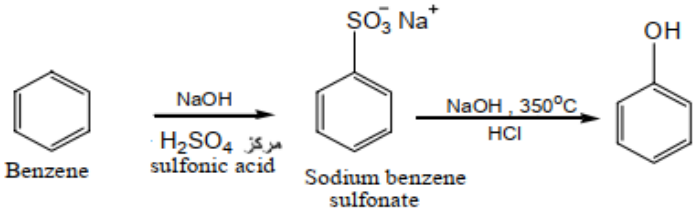
2- Cumene

Most phenol is present time made from cumene, where cumene is treated with acid in atmospheric air at high temperatures.



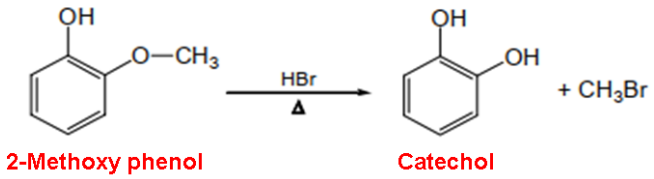
3- Benzene

It is prepared from benzene by converting it to sodium benzene sulfonate, then melting it with alkali and treating it with hydrochloric acid as follows:



4- Ethers

Catechol is prepared from 2-Methoxy phenol as follows

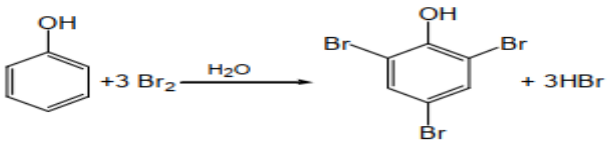


Ractions of Phenols

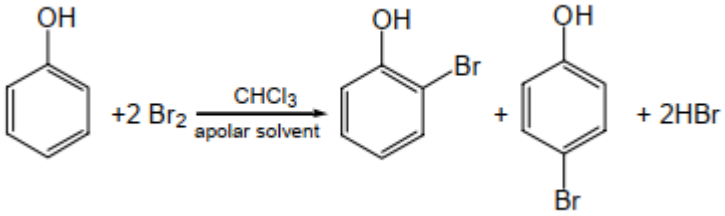
Electrophilic substitution reactions

1- Halogenation

Phenol reacts with bromine in an aqueous solution(H_2O) **polar solvent** gives a three-substituted phenol

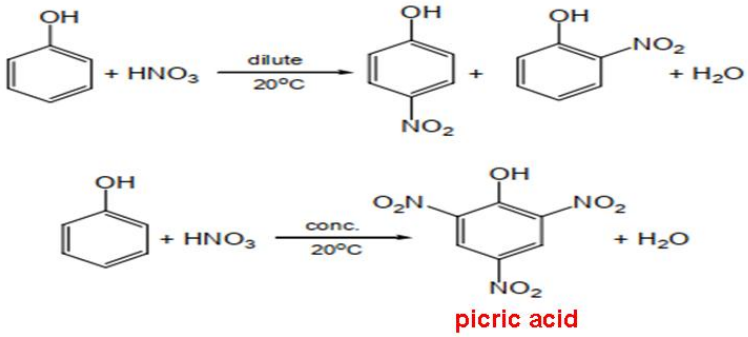


When the reaction is carried out using a **non-polar solvent** such as chloroform, a mixture of para and ortho forms is produced



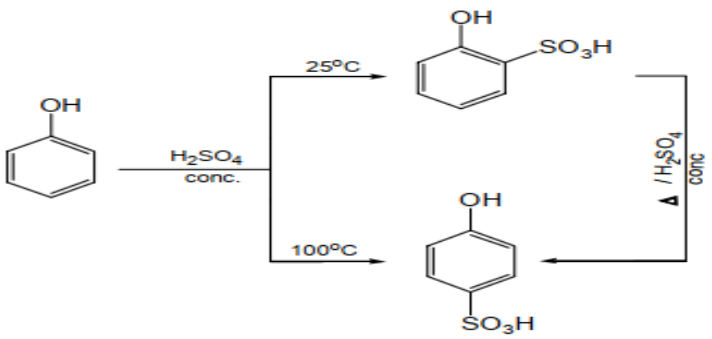
2- Nitration

Phenol reacts with dilute nitric acid at low temperatures to give a mixture of ortho and para form, and it reacts with concentrated acid to produce picric acid.



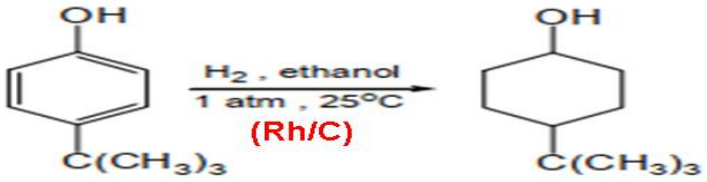
3- Sulfonation:

Phenol reacts with concentrated sulfuric acid to give an ortho-form at low temperatures and a para-form at high temperatures.



4- Hydrogenation

The aromatic ring is hydrogenated by using rhodium with carbon as a catalyst in the presence of hydrogen gas.



phenols usea in pharmacy

Phenols, which are aromatic compounds characterized by a hydroxyl (-OH) group attached directly to a benzene ring, have several important uses in pharmacy:

1. **Antiseptics and Disinfectants**: Phenol itself and its derivatives, such as chloroxylenol (used in Dettol), have strong antiseptic properties. They are used in solutions for disinfecting skin and wounds, as well as in surgical scrubs and sanitizing solutions.
2. **Preservatives**: Some phenolic compounds, like thymol and phenol itself, are used as preservatives in pharmaceutical formulations. They help prevent microbial growth and extend the shelf life of multi-dose preparations like oral syrups and nasal sprays.
3. **Topical Antimicrobials**: Phenolic compounds are used in topical preparations to treat skin infections and conditions such as acne. They possess both antibacterial and antifungal properties, making them effective against a wide range of pathogens.
4. **Local Anesthetics**: Some phenolic compounds, such as phenol derivatives like cresols, have local anesthetic properties. They can be used topically to numb minor skin irritations and relieve pain.
5. **Antioxidants**: Phenolic compounds like alpha-tocopherol (vitamin E) are used as antioxidants in pharmaceutical formulations. They help protect

drugs and other ingredients from oxidative degradation, thereby maintaining their stability and efficacy.

6. **Expectorants**: Certain phenolic compounds, such as guaifenesin (a derivative of guaiacol), are used as expectorants in cough and cold preparations. They help loosen mucus and facilitate its removal from the respiratory tract.
7. **Antioxidant Preservatives**: Phenolic antioxidants like butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) are used as preservatives in pharmaceuticals to prevent oxidation of active ingredients and extend shelf life.
8. **Anti-inflammatory Agents**: Some phenolic compounds exhibit anti-inflammatory properties and are used in formulations for treating inflammatory conditions, such as arthritis and dermatitis.

These diverse applications highlight the significance of phenolic compounds in pharmaceuticals, where they contribute to antimicrobial efficacy, formulation stability, and therapeutic benefits.

Questions after the lecture

اسئلة البعدية

Q1: Fill in the blanks to complete the meaning of the following sentences:

1-Phenols have high boiling points due to their ability to form _____ between their molecules.

2- The phenyl ring in phenols withdraws electrons, increasing the _____of the OH bond in the hydroxyl group

3- Phenols typically have _____ solubility in water due to their carbon structure containing at least six carbon atoms.

4- The solubility of phenols can be increased by adding more _____ groups on the ring.

5- The solubility of phenol in water is approximately ____ g/100ml H_2O.

6-Catechol, with a solubility of _____ g/100ml H_2O, demonstrates higher solubility than phenol due to its structure.

Q1: Starting from cumene, prepare phenol

Q2: Starting from benzene, prepare phenol

Q3: Enumerate of method to prepare phenol and its derivatives, giving an example for each method.

Q4: Enumerate of types of phenol, giving an example for each.

Q5: What is the result of reacts bromine Br_2 with phenol in an aqueous solution (H_2O) and a non-polar solvent (chloroform) Support your answer with equations.

Q6: What is the difference between the reaction of phenol with diluted and concentrated nitric acid? Support your answer with equations.

Q7: What is the difference between the reaction of phenol with sulfuric acid at low and high temperatures? Support your answer with equations

Q8: What is the result of reacts 2-hydroxy benzensulfonic with concentrated sulfuric acid at high temperatures.

The basic References المصادر الاساسية

- **"Organic Chemistry"** by Paula Yurkanis Bruice
- **"Organic Chemistry" by John McMurry**
- **"Organic Chemistry: A Short Course"** by Harold Hart and Leslie E. Craine
- "**Organic Chemistry" لـ Jonathan Clayden, Nick Greeves, Stuart Warren, و Peter Wothers.**
- **التطبيقات التعليمية**:

- ChemDraw: برنامج لرسم المركبات العضوية والتفاعلات

قواعد البيانات الكيميائية:

- **ChemSpider: قاعدة بيانات للمركبات الكيميائية تقدم معلومات حول الخصائص والهياكل الكيميائية.**
- **PubChem: قاعدة بيانات للمركبات الكيميائية تتضمن معلومات عن الهياكل والخواص والاستخدامات**