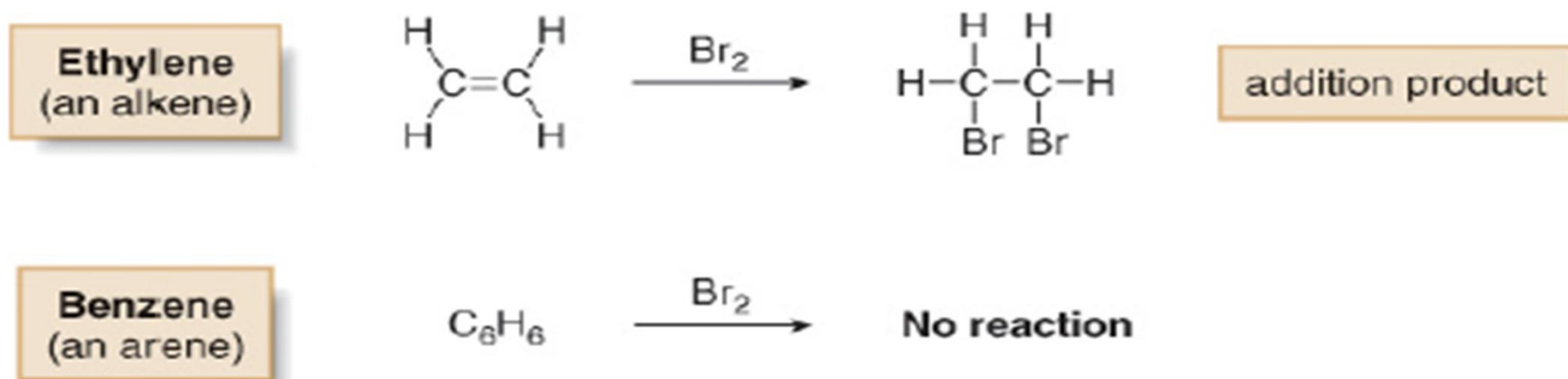
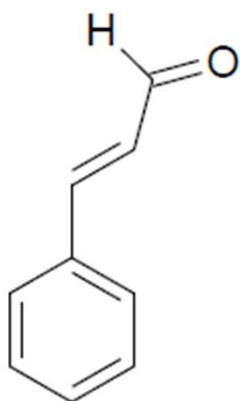


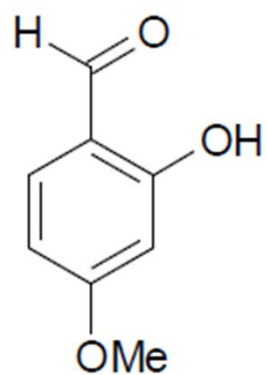
Aromatic compound

- Benzene (C₆H₆) is the simplest aromatic hydrocarbon (or arene).
- Benzene has four degrees of unsaturation, making it a highly unsaturated hydrocarbon.
- Whereas unsaturated hydrocarbons such as alkenes, alkynes and dienes readily undergo addition reactions, benzene does not.

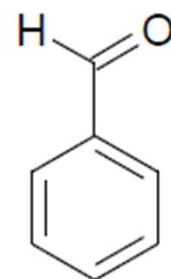




Cinamaldehyde



Vaniline



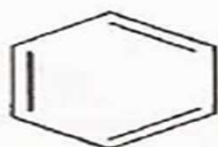
benzaldehyde

- Benzene does react with bromine, but only in the presence of FeBr_3 (a Lewis acid), and the reaction is a substitution, not an addition.



substitution
Br replaces H

- Proposed structures of benzene must account for its high degree of unsaturation and its lack of reactivity towards electrophilic addition.
- **August Kekulé** proposed that benzene was a rapidly equilibrating mixture of two compounds, each containing a six-membered ring with three alternating π bonds.
- In the Kekulé description, the bond between any two carbon atoms is sometimes a single bond and sometimes a double bond.



44



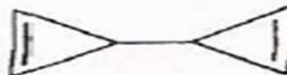
45



46



47

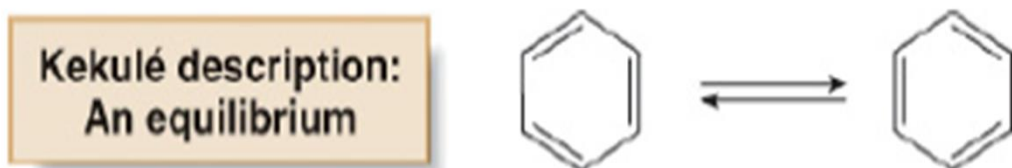


48



49

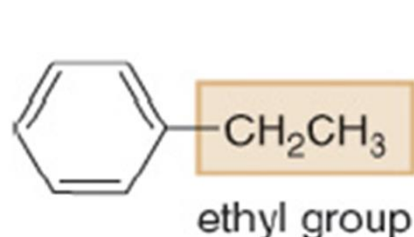
- These structures are known as **Kekulé structures**.



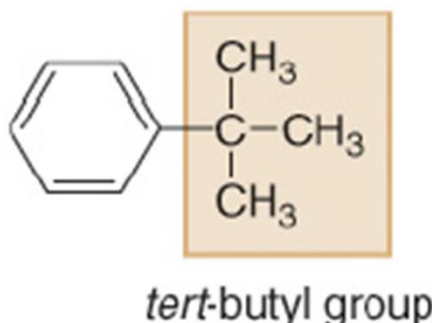
- Although benzene is still drawn as a six-membered ring with alternating π bonds, in reality there is no equilibrium between the two different kinds of benzene molecules.
- Current descriptions of benzene are based on resonance and electron delocalization due to orbital overlap.
- In the nineteenth century, many other compounds having properties similar to those of benzene were isolated from natural sources. Since these compounds possessed strong and characteristic odors, they were called aromatic compounds. It should be noted, however, that it is their chemical properties, and not their odor, that make them special.

Nomenclature of Benzene Derivatives

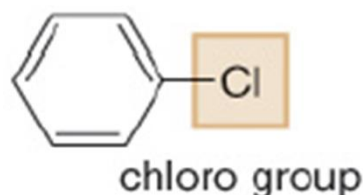
- To name a benzene ring with one substituent, name the substituent and add the word benzene.



ethylbenzene

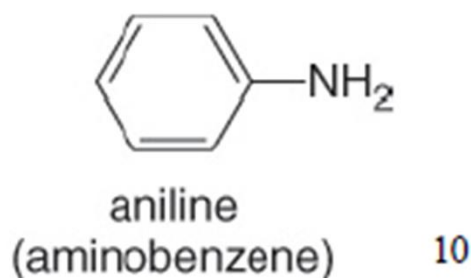
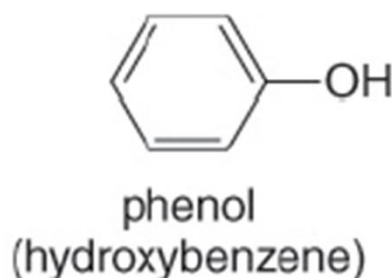
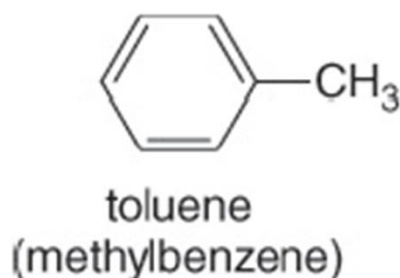


tert-butylbenzene



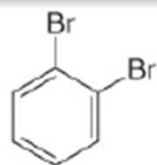
chlorobenzene

- Many monosubstituted benzenes have common names which you must also learn.



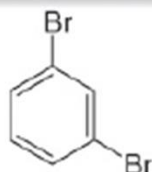
- There are three different ways that two groups can be attached to a benzene ring, so a prefix—**ortho**, **meta**, or **para**—can be used to designate the relative position of the two substituents.

1,2-disubstituted benzene
ortho isomer



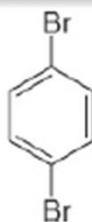
ortho-dibromobenzene
or
o-dibromobenzene
or 1,2-dibromobenzene

1,3-disubstituted benzene
meta isomer



meta-dibromobenzene
or
m-dibromobenzene
or 1,3-dibromobenzene

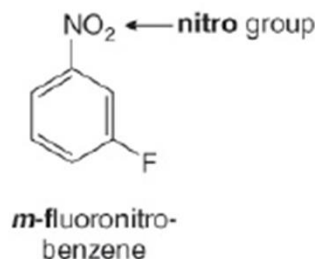
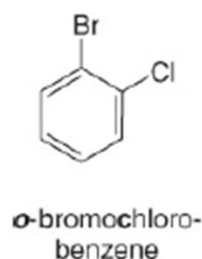
1,4-disubstituted benzene
para isomer



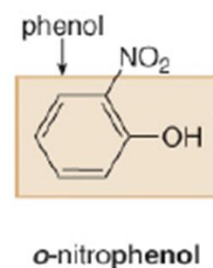
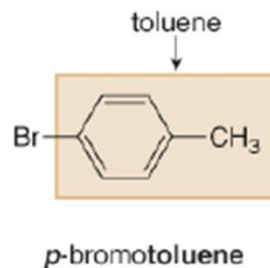
para-dibromobenzene
or
p-dibromobenzene
or 1,4-dibromobenzene

- If the two groups on the benzene ring are different, alphabetize the names of the substituents preceding the word benzene.
- If one substituent is part of a common root, name the molecule as a derivative of that monosubstituted benzene.

Alphabetize two different substituent names:



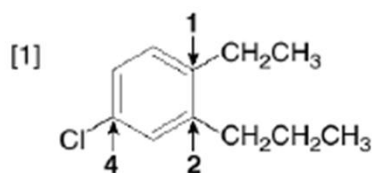
Use a common root name:



For three or more substituents on a benzene ring:

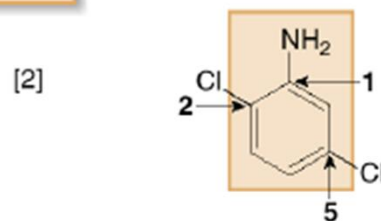
1. Number to give the lowest possible numbers around the ring.
2. Alphabetize the substituent names.
3. When substituents are part of common roots, name the molecule as a derivative of that monosubstituted benzene. The substituent that comprises the common root is located at C1.

Examples of naming polysubstituted benzenes



- Assign the lowest set of numbers.
- Alphabetize the names of all the substituents.

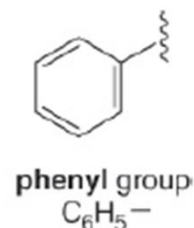
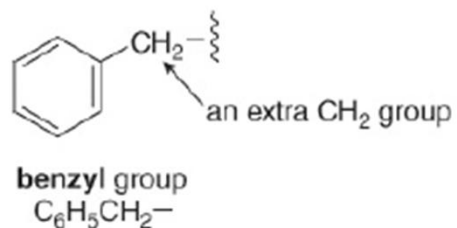
4-chloro-1-ethyl-2-propylbenzene



- Name the molecule as a derivative of the common root **aniline**.
- Designate the position of the NH_2 group as "1," and then assign the lowest possible set of numbers to the other substituents.

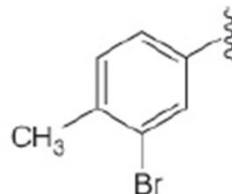
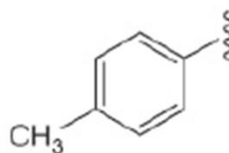
2,5-dichloroaniline

- The **benzyl group**, another common substituent that contains a benzene ring, differs from a phenyl group.

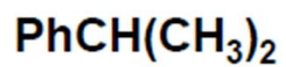


- Substituents derived from other substituted aromatic rings are collectively known as **aryl groups**.

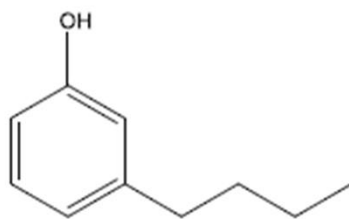
Examples of
aryl groups



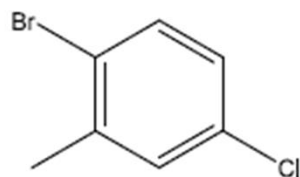
Give the IUPAC name for each compound.



isopropylbenzene



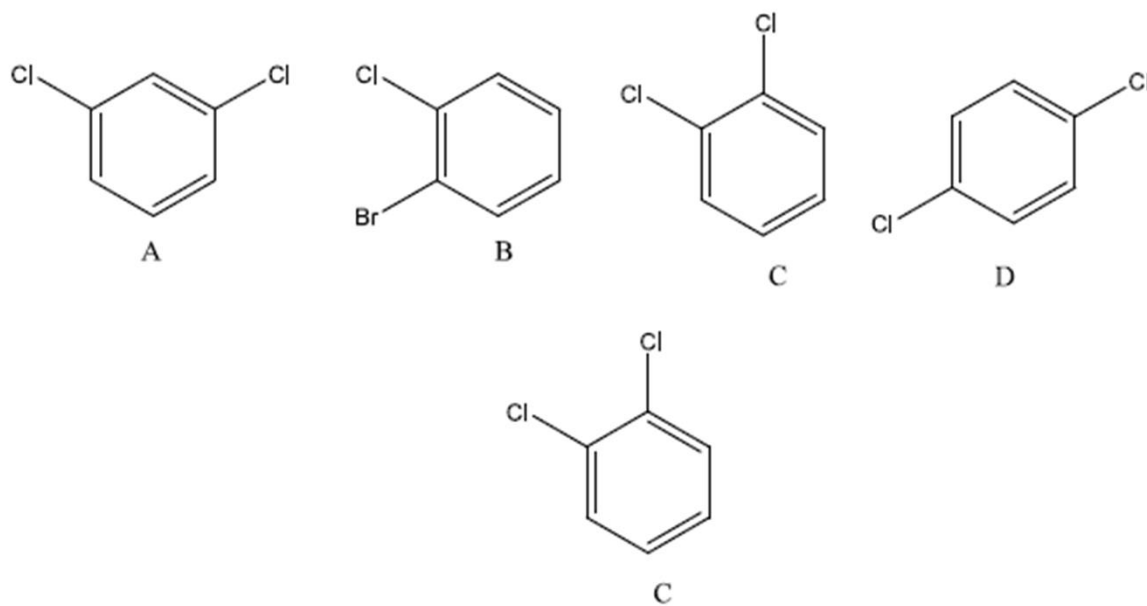
m-butylphenol



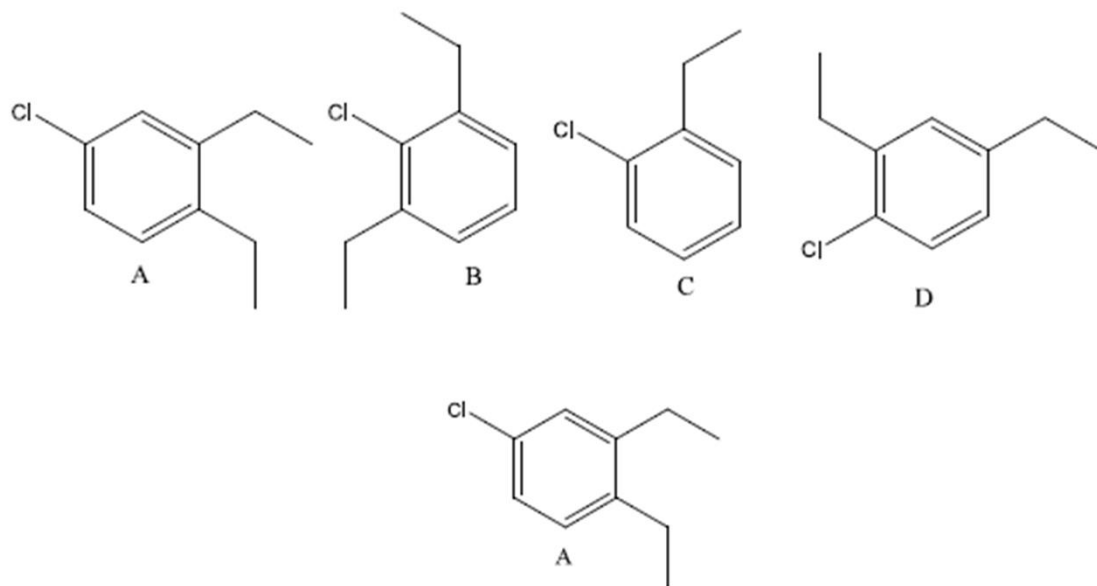
2-bromo-5-chlorotoluene

Which structure matches the given name?

o-dichlorobenzene

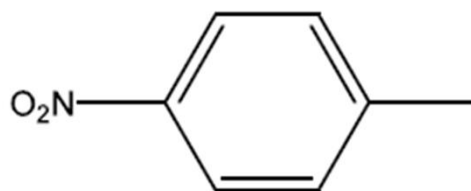


4-chloro-1,2-diethylbenzene



What is the correct name for this compound?

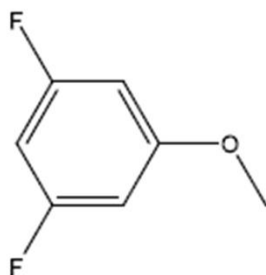
- A) 3-Nitrotoluene
- B) 4-Nitromethylbenzene
- C) *p*-Nitrotoluene
- D) (4,1)-Methylnitrobenzene



C) *p*-Nitrotoluene

What is the correct name for this compound?

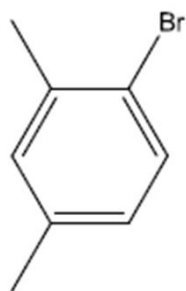
- A) 3,5-difluoroanisole
- B) Difluoromethoxybenzene
- C) 1,5-difluoro-3-methoxybenzene
- D) 1,3-difluoro-5-methyl-O-benzene



3,5-difluoroanisole

What is the correct name for this compound?

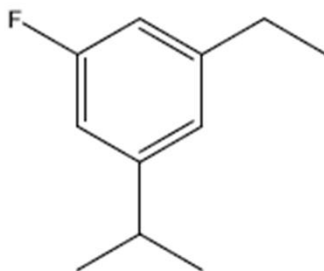
- A) 4-bromo-*m*-xylene.
- B) 1-bromo-2,4-dimethylbenzene.
- C) *p*-bromo-*m*-methyltoluene.
- D) *o*-bromo-*m*-methyltoluene.



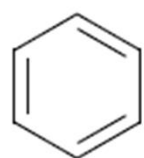
B) 1-bromo-2,4-dimethylbenzene.

What is the correct name?

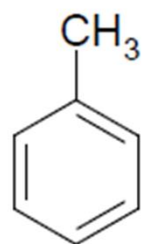
- A) 1-fluoro-3-isopropyl-5-ethylbenzene
- B) 1-ethyl-3-isopropyl-5-fluorobenzene
- C) 1-ethyl-3-fluoro-5-isopropylbenzene
- D) 1-isopropyl-3-fluoro-5-ethylbenzene



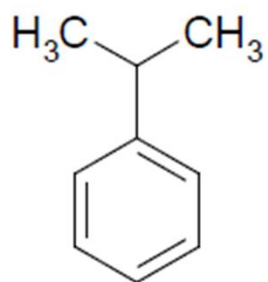
C) 1-ethyl-3-fluoro-5-isopropylbenzene



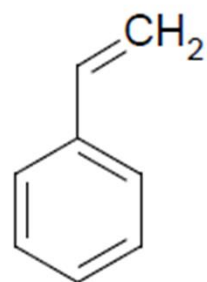
benzene



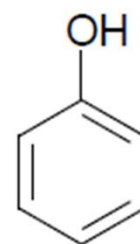
toluene



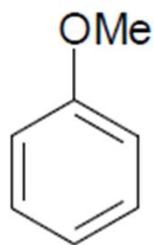
cumene



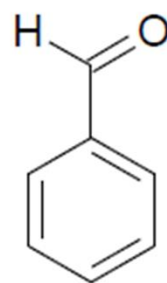
styrene



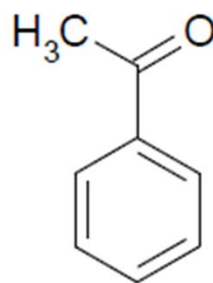
phenol



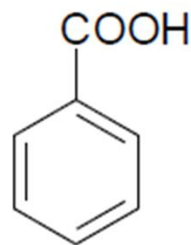
anisole



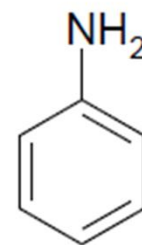
benzaldehyde



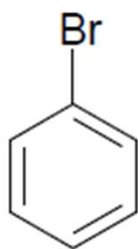
acetophenone



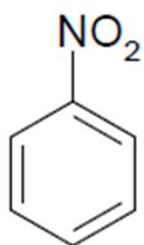
benzoic acid



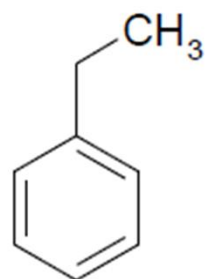
aniline



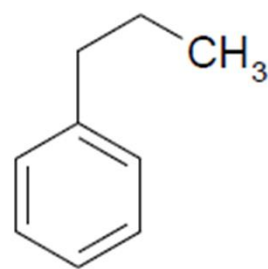
bromobenzene



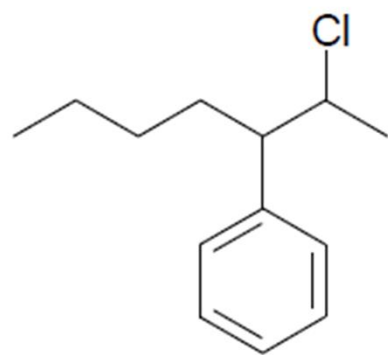
nitrobenzene



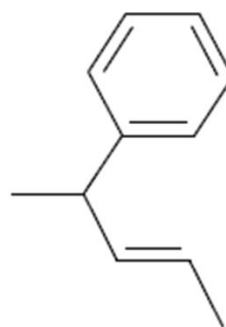
ethyl benzene



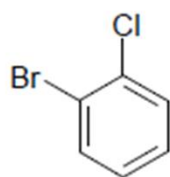
propylbenzene



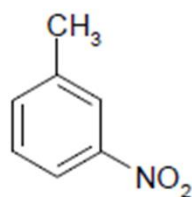
2-chloro-3-phenylheptane



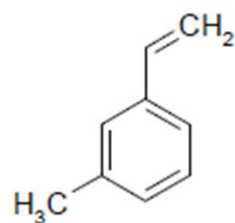
E-4-phenyl-2-pentene



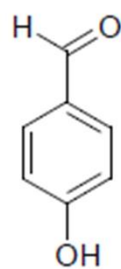
o-bromochlorobenzene
(alphabetical order)



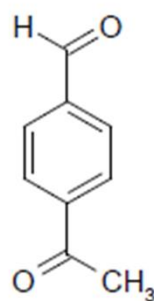
m-nitrotoluene



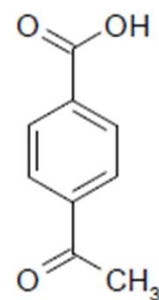
m-methylstyrene



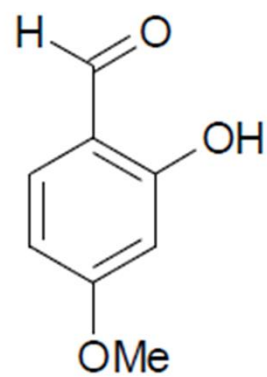
4-hydroxybenzaldehyde



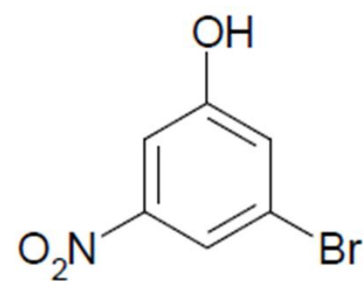
4-acetylbenzaldehyde



4-acetylbenzoic acid

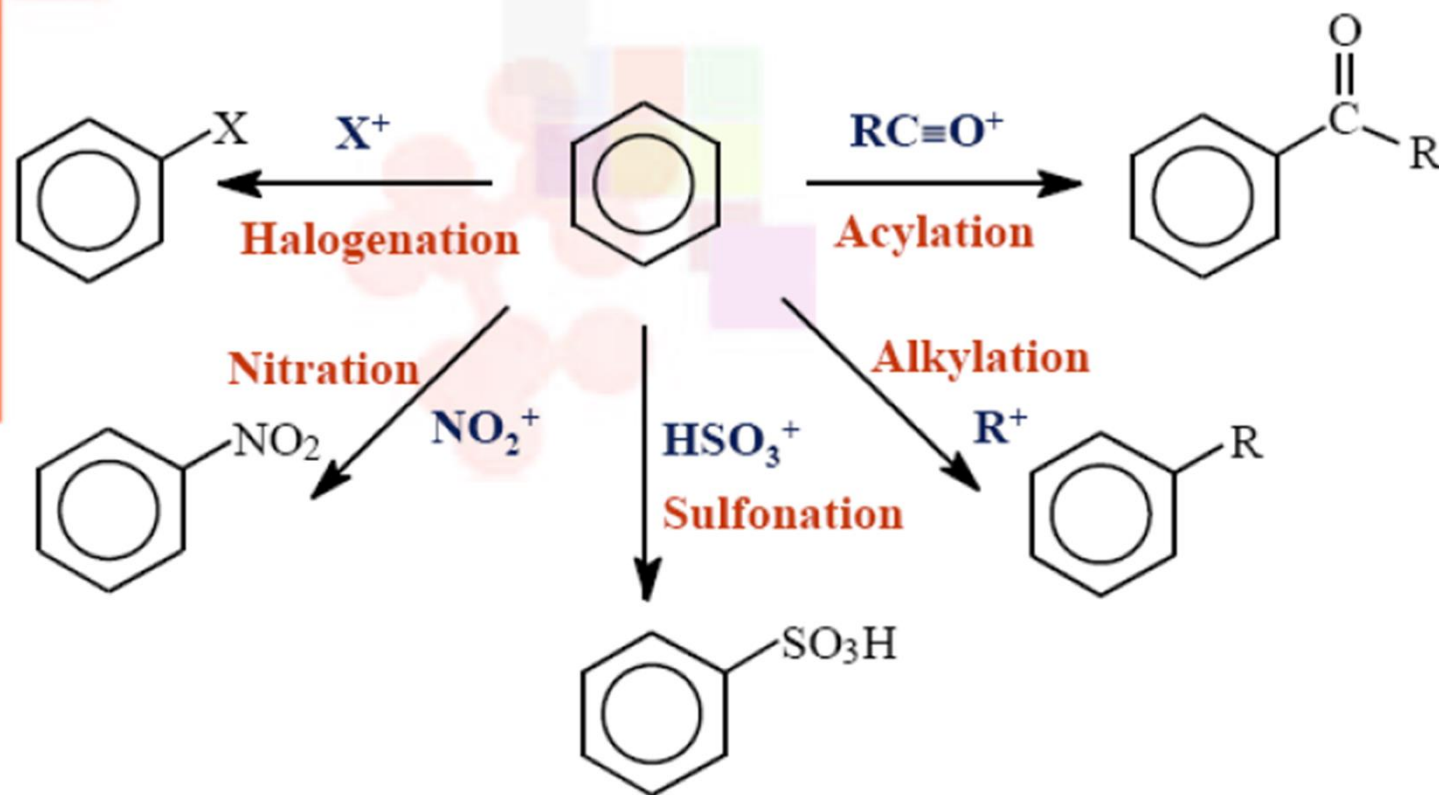


2-hydroxy-3-methoxybenzaldehyde
(Vaniline)

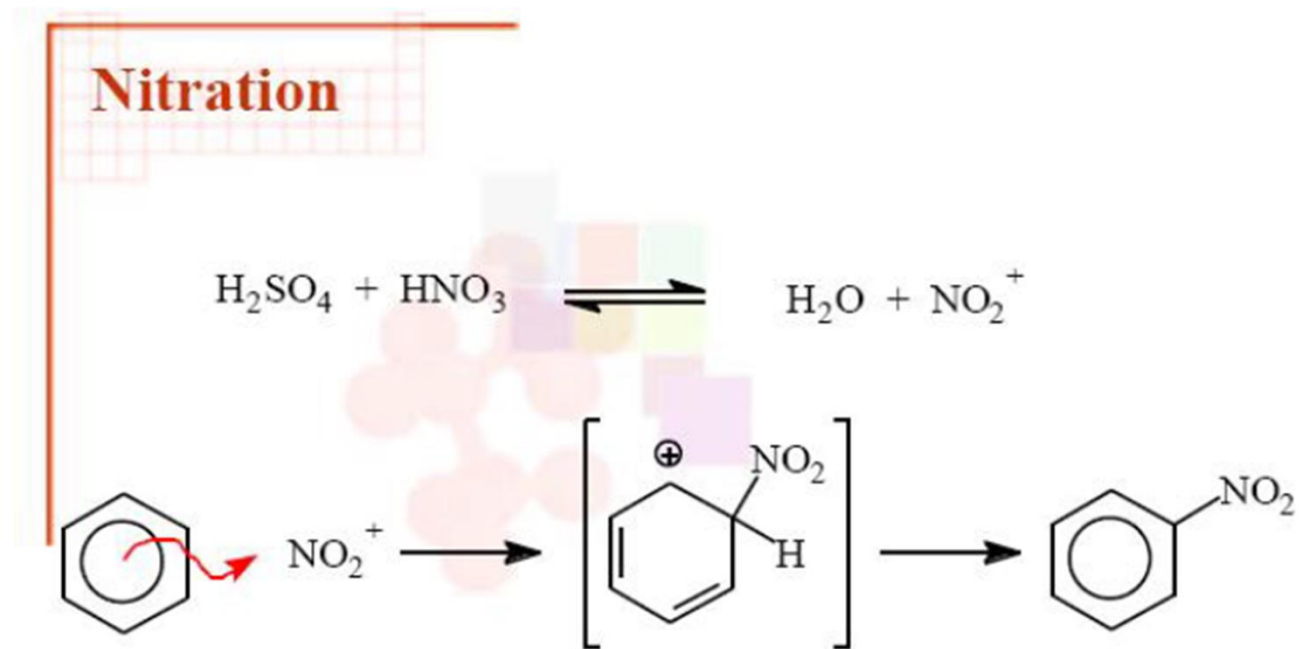


3-bromo-5-nitrophenol

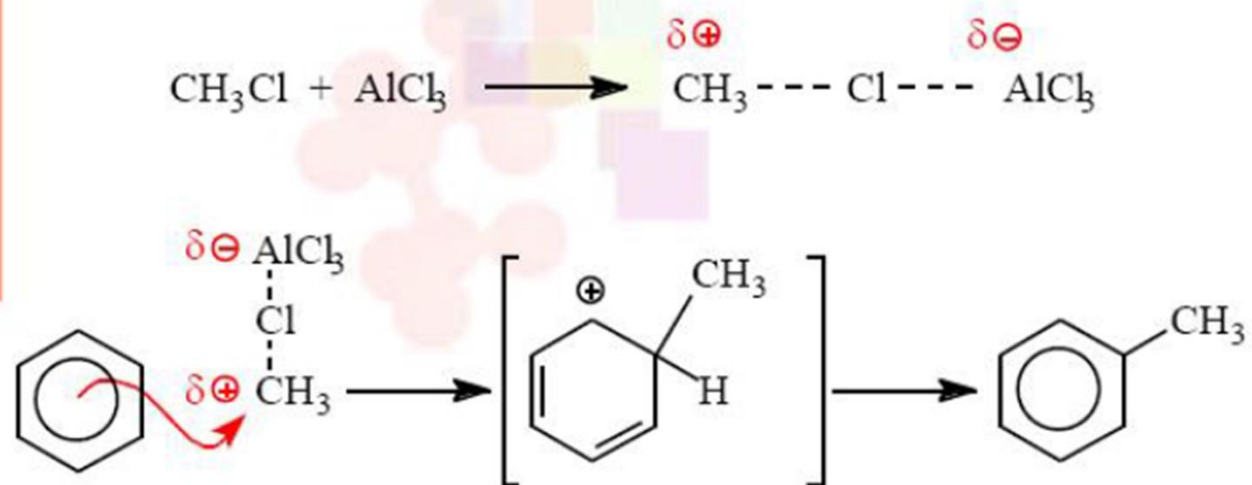
Electrophilic Aromatic Substitution



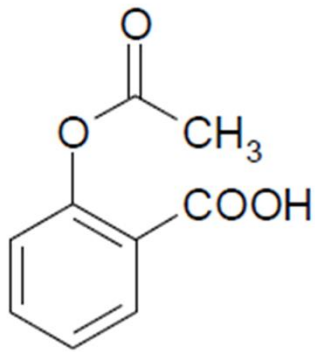
أما في تفاعل النترنة (nitration)، فيتم الحصول على الإلكتروفيل (NO_2^+) بخلط حامض النيتريك مع حامض الكبريتيك، ويتضح ذلك من المعادلة التالية:



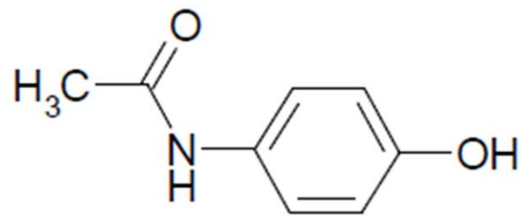
Friedel-Crafts Alkylation



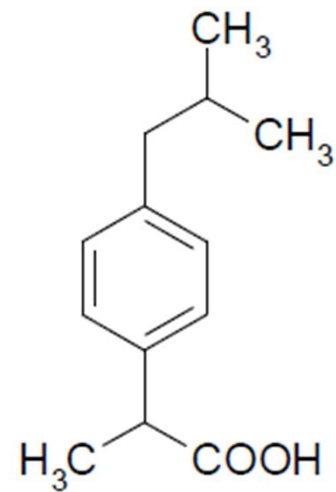
Some drug use as analgesic



Aspirin



Paracetamol



Ibuprofen