

## شرح الدرس الخامس Hydrocarbons Aromatic من وحدة Hydrocarbons منهج انسباير



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المزيد من مادة  
كيمياء:

إعداد: Mouad

### التواصل الاجتماعي بحسب الصف الحادي عشر المتقدم



صفحة المناهج  
الإماراتية على  
فيسبوك

الرياضيات

اللغة الانجليزية

اللغة العربية

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المواد على تلغرام

### المزيد من الملفات بحسب الصف الحادي عشر المتقدم والمادة كيمياء في الفصل الثالث

شرح الدرس الرابع Isomers Hydrocarbon من وحدة Hydrocarbons منهج انسباير

1

شرح الدرس الثالث Alkynes and Alkenes من وحدة Hydrocarbons منهج انسباير

2

شرح الدرس الثاني Alkanes من وحدة Hydrocarbons منهج انسباير

3

شرح الدرس الأول hydrocarbons to Introduction من وحدة Hydrocarbons منهج انسباير

4

حل مراجعة نهائية وفق الهيكل الوزاري الخطة C

5

# Aromatic Hydrocarbons

Alef Lessons:  
69 and 70.

## *Learning objectives:*

- ❖ **Describe** the structure of benzene and its reactivity
- ❖ **Distinguish** among aliphatic and aromatic hydrocarbons
- ❖ Use IUPAC system **to name** the aromatic compounds
- ❖ **Draw** the structure of an aromatic compound given its name
  - ▀ **Compare and contrast** the properties of aromatic and aliphatic hydrocarbons.
  - ▀ **Explain** what a carcinogen is, and

The top banner features several chemistry-related illustrations: a flask with bubbling liquid on the left, a test tube with orange liquid in the center, and a Bohr-style atomic model with a yellow nucleus and three electrons on the right. The word "CHEMISTRY" is written in white capital letters across the top.

CHEMISTRY

# “Hydrocarbons”

## \*Aromatic Hydrocarbons\*

Mr. Mouad

مناهج دولة الإمارات

عام، متقدم ونخبة 9،10،11،12

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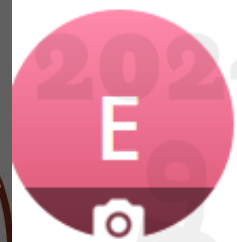
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Inspire Chemistry

Module 20

**“Hydrocarbons”**

**\*Aromatic Hydrocarbons\***

# Learning Outcomes:

- ▶ **Compare and contrast** the properties of aromatic and aliphatic hydrocarbons.
- ▶ **Explain** what a carcinogen is and list some examples.





# *The Big Picture*



*Natural Oil "Perfume"*



*Dyes (صبغات وملونات)*

What do they have in common?

They contain hydrocarbon rings, **mainly**

**Benzene " $\text{C}_6\text{H}_6$ "!**

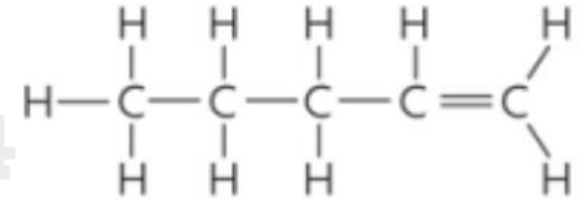
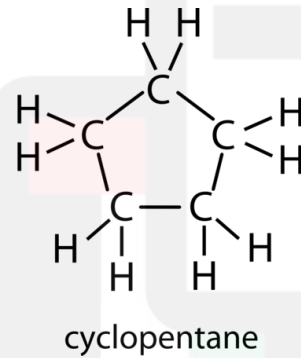
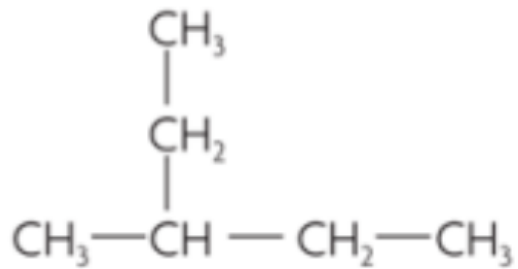
## Starter

Match each keyword with its proper structure below

Ring/cyclic structure

Straight-chain

Branched chain





## EXPAND YOUR THINKING

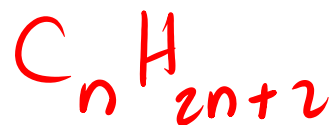
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To which family of hydrocarbons do you think " $C_6H_6$ " belongs to?

What is its name?

Which structure does it have?

Alkanes



Alkenes



Alkynes



# New Vocabulary

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aromatic compounds

aliphatic compound



## Review Vocabulary

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**hybrid orbitals:** equivalent atomic orbitals that form during bonding by the rearrangement of valence electrons

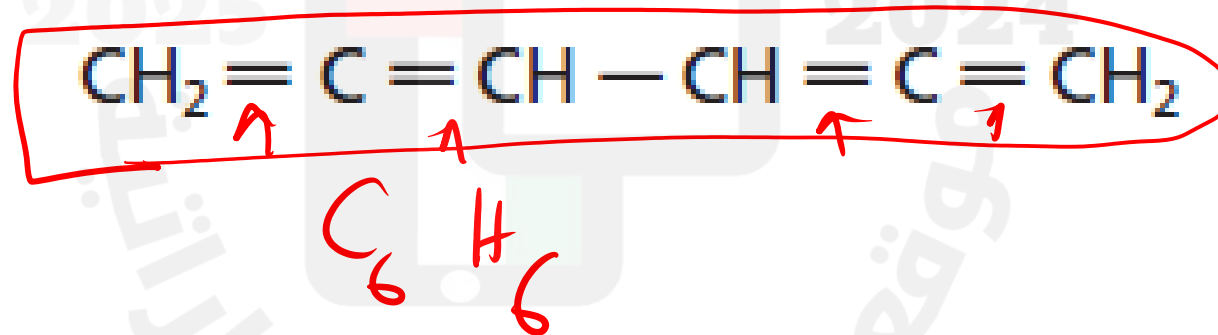


# The Structure of Benzene

Alkane  $C_6H_{14}$

- Benzene molecule  $C_6H_6$

Because the benzene molecule had so few hydrogen atoms, chemists reasoned that **it must be unsaturated**; that is, **it must have several double or triple bonds, or a combination of both**. They proposed many different structures, including this one suggested in 1860.



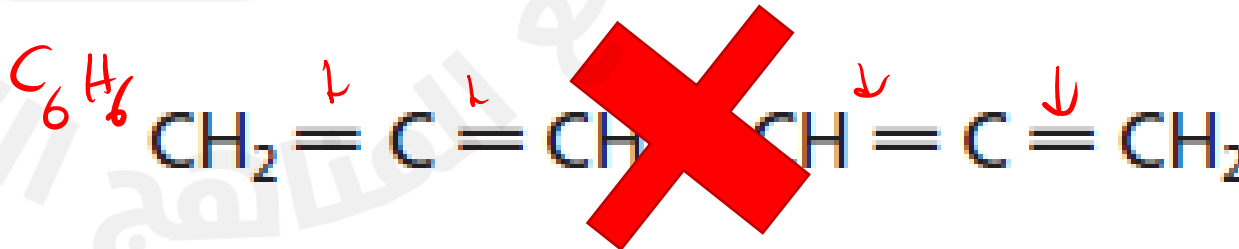
# The Structure of Benzene

- Benzene molecule  $C_6H_6$

Although this structure has a molecular formula of  $C_6H_6$ , such a hydrocarbon would be **unstable** and **extremely reactive** because of its many double bonds.

However, **benzene was fairly unreactive**, and it did not react in the ways that alkenes and alkynes usually react.

For that reason, chemists reasoned that structures such as the one shown below must **be incorrect**.

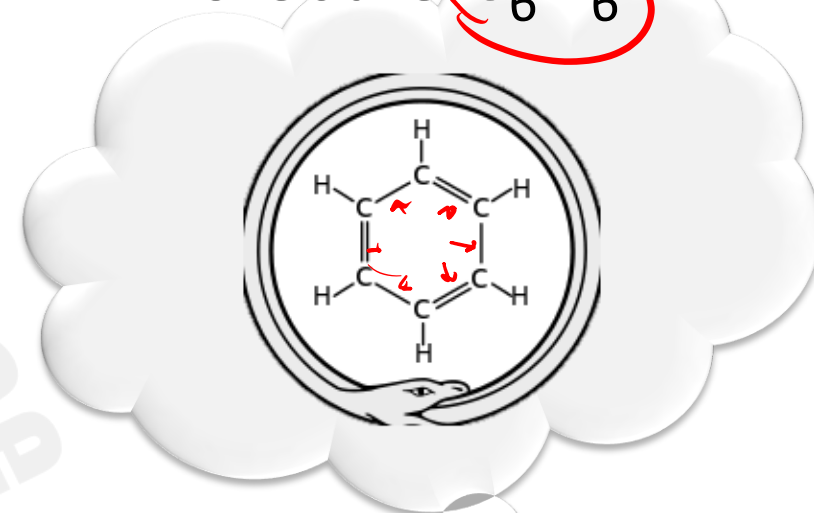


# The Structure of Benzene



- **Kekulé's dream:** Kekulé proposed a different kind of structure for benzene— a hexagon of carbon atoms with alternating single and double bonds.
- Kekulé claimed that benzene's structure came to him in a dream.
- The flat, hexagonal structure Kekulé proposed explained some of the properties of benzene, **but it did not explain benzene's lack (افتقاد) of reactivity!!!**

• Benzene molecule  $C_6H_6$



What can explain why Kekulé model  
of  $C_6H_6$  (Benzene) lack high  
reactivity???



# Kekulé Structure (Isomers)



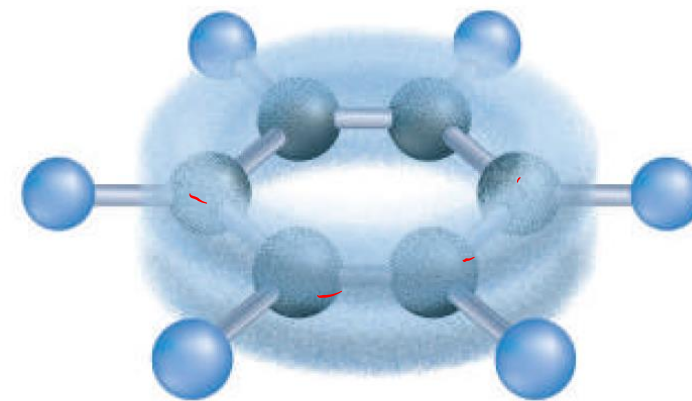
What is the difference between both structures?

**Alternating single and double bonds.**

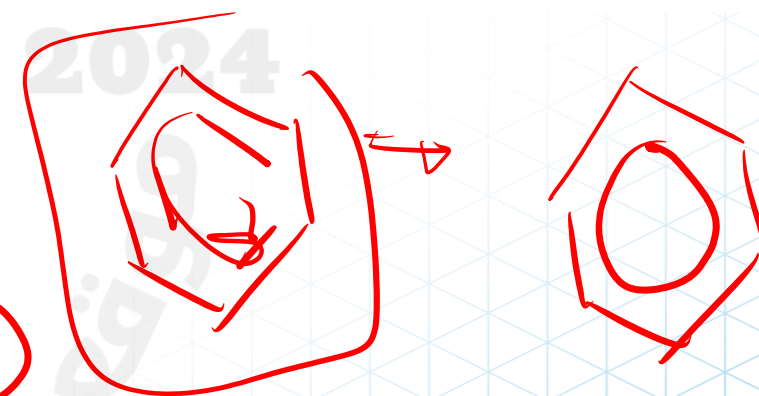
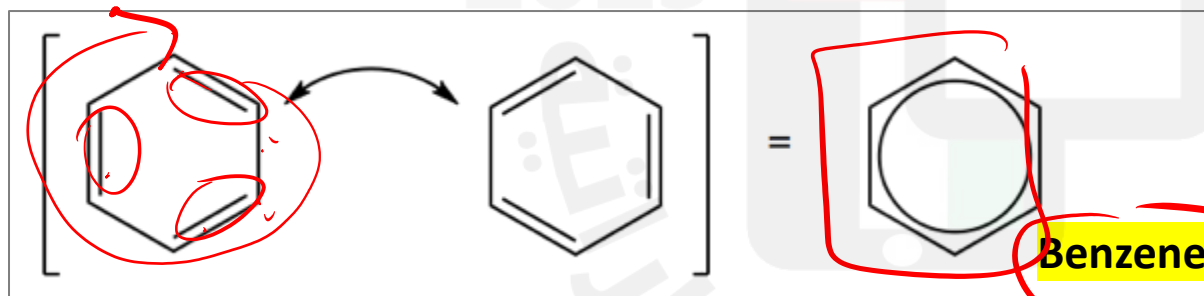
**The double bonds are changing their places.**

# The Structure of Benzene

- Linus Pauling's hybrid orbital theory explained benzene's lack of reactivity.
- This theory predicts that the **pairs of electrons that form the second bond** of each of benzene's double bonds are shared among all six carbons' nuclei in the ring.
- This makes benzene chemically stable **because electrons shared by six carbon nuclei are hard to pull away**.



■ **Figure 25** Benzene's bonding electrons spread evenly in a double-donut shape around the ring instead of remaining near individual atoms.



# Quiz

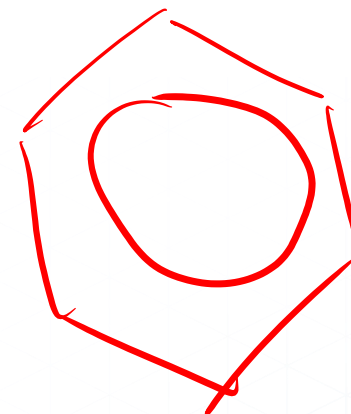
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1. What did **Friedrich Kekulé's** proposed structure of benzene **fail to explain**?

- A its reactivity
- B its lack of reactivity**
- C its boiling point
- D its melting point

## Quiz

2. Which of the following **best describes the structure of benzene** as it is understood today?



- A** It is a ring structure.
- B** It is a linear structure. ✗
- C** It is a ring structure with six carbon atoms. ✓
- D** It is a ring structure in which electrons are shared by six carbon nuclei.

# Check Your Understanding

Select the correct answer.



Which of the following statements applies to benzene?

~~I~~: contains 12 hydrogen atoms

II: unsaturated hydrocarbon ✓

III: undergoes addition reactions

~~☐~~ only I and II

☐ only II and III

~~☐~~ I only

☒ II only

Benzene



# Aromatic Compounds vs. Aliphatic Compounds

Aromatic  
compounds

Organic compounds  
that **contain benzene  
rings** as part of their  
structures



Aliphatic  
compounds

Hydrocarbons such as  
the alkanes,  
alkenes, and alkynes.  
**NO benzene rings**

# Aromatic Compounds

---

- Organic compounds that contain benzene rings are called **aromatic compounds**.
- The term aromatic was originally used because many of the benzene-related compounds known in the nineteenth century were found in pleasant-smelling oils that came from spices, fruits, and other plant parts.



# Aromatic Compounds

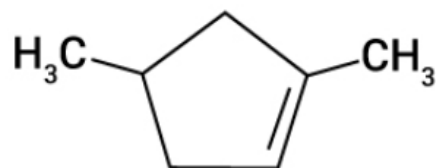
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- Hydrocarbons such as the alkanes, alkenes, and alkynes are called **aliphatic compounds** to distinguish them from aromatic compounds.
- The term aliphatic comes from the Greek word for *fat* because the compounds were obtained by heating animal fat.

# Check Your Understanding

Select the **CORRECT** answer.

Study the four structures below. Which of the compounds is aromatic?



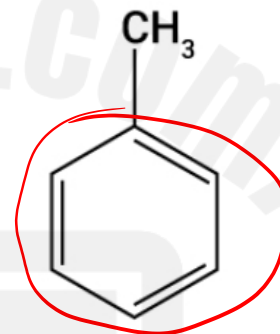
compound A



compound B



compound C



compound D

A, C, and D

☐ A, B, C, and D

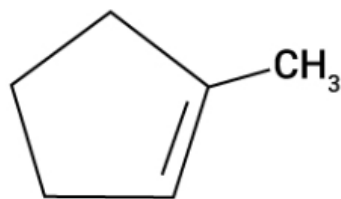
C and D

☒ only D

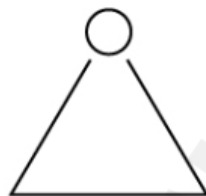
# Check Your Understanding

Select the **CORRECT** answer.

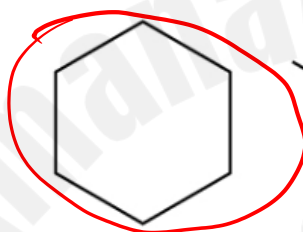
Study the four structures below. Which of the compounds is aliphatic?



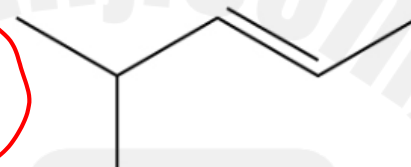
compound A



compound B

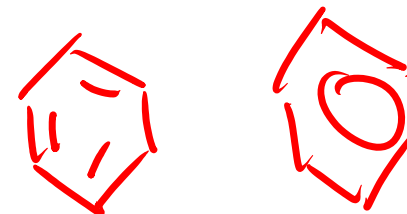


compound C



compound D

*No benzene*



*cyclohexane*

A, C, and D



A, B, C, and D

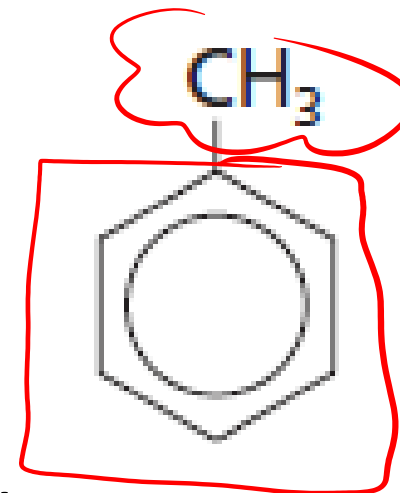
C and D



only D

All of the compounds are aliphatic as none consist of benzene rings.

# THINK!



How can we name aromatic compounds like this?

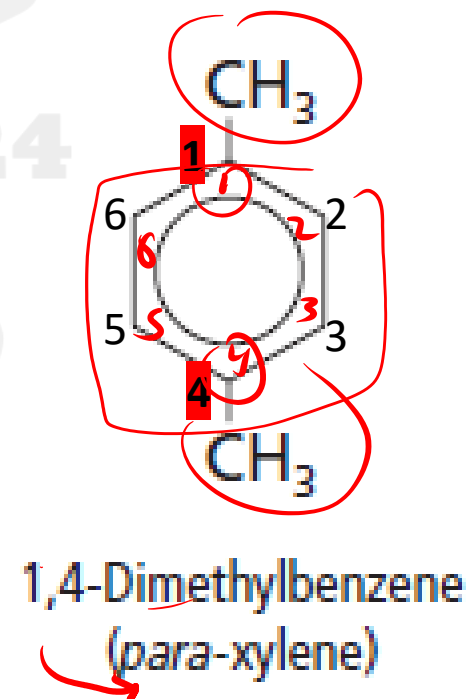
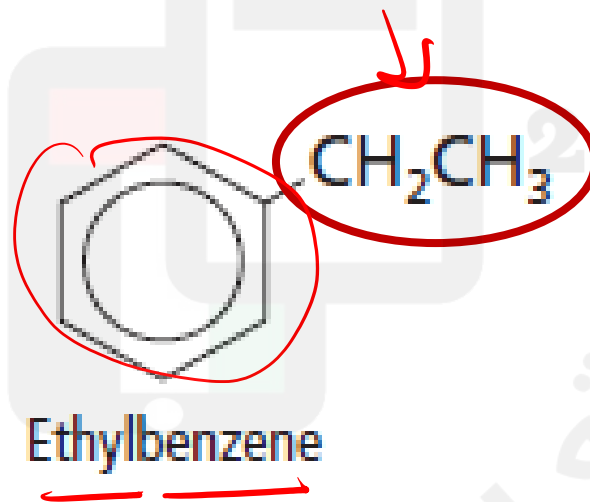
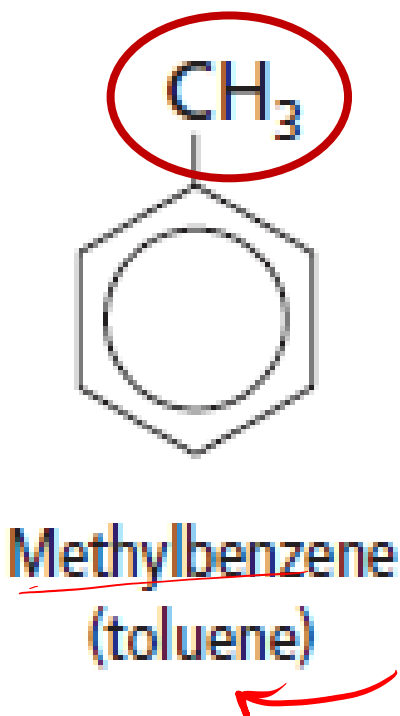
**Try on your own first.**

**Hint:** Remember how we name cycloalkanes or cycloalkenes

*methylbenzene*

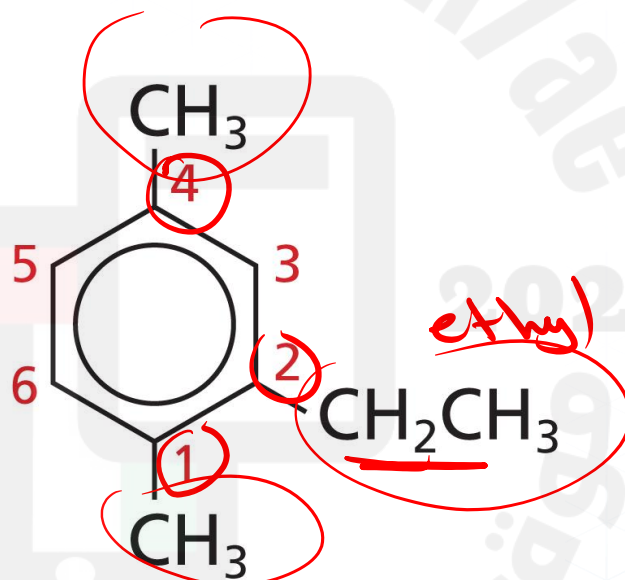
# Naming substituted aromatic compounds

- **Substituted benzene compounds** are named in the same way as **cyclic alkanes**.
- For example, **ethylbenzene** has a 2-carbon ethyl group attached, and 1,4-dimethylbenzene, also known as *para*-xylene, has two methyl groups attached at Positions 1 and 4.



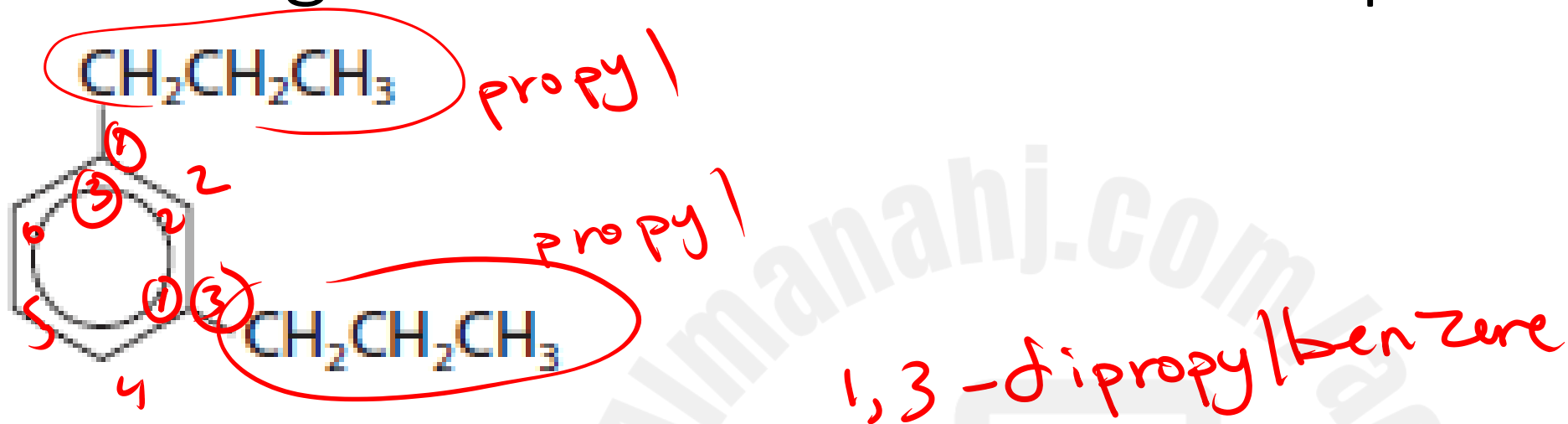
# Aromatic Compounds

Substituted benzene compounds are named in the same way as cycloalkanes.



2-Ethyl-1,4-dimethylbenzene

# Naming substituted aromatic compounds



**1,3-dipropylbenzene**



## Quiz

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4. What is the name of the compound in which one ethyl group is attached to a benzene ring?

**A** diethylbenzene

**C** ethylbenzene

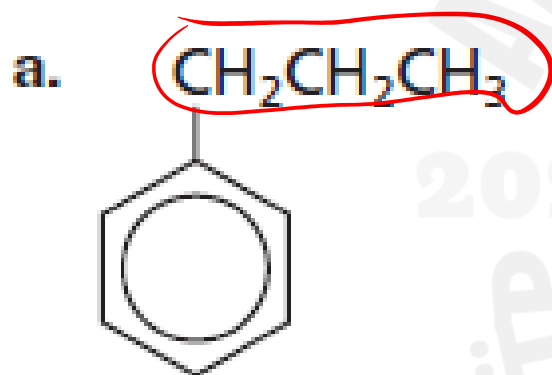
**B** 1-ethylbenzene

**D** toluene

# Check

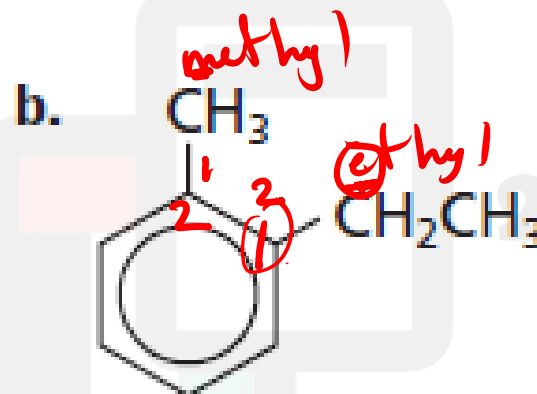
Name the following structures.

propyl benzene



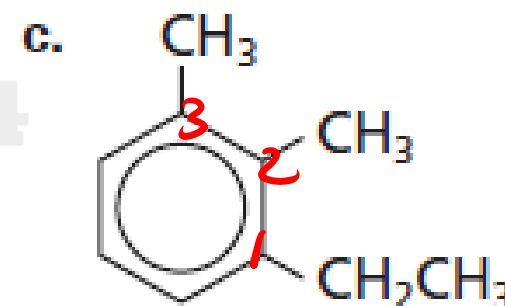
propylbenzene

1-ethyl-2-methyl benzene



1-ethyl-2-methylbenzene

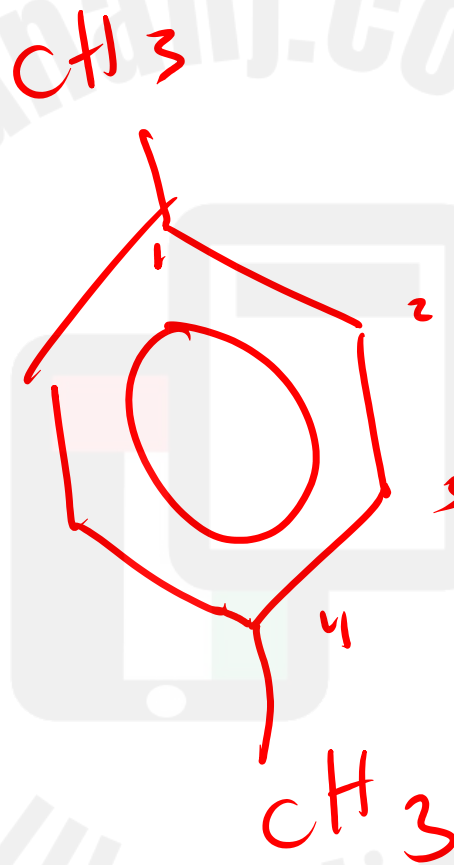
1-ethyl-2,3-dimethyl benzene



1-ethyl-2,3-dimethylbenzene

# Check

**Challenge** Draw the structure of 1,4-dimethylbenzene.



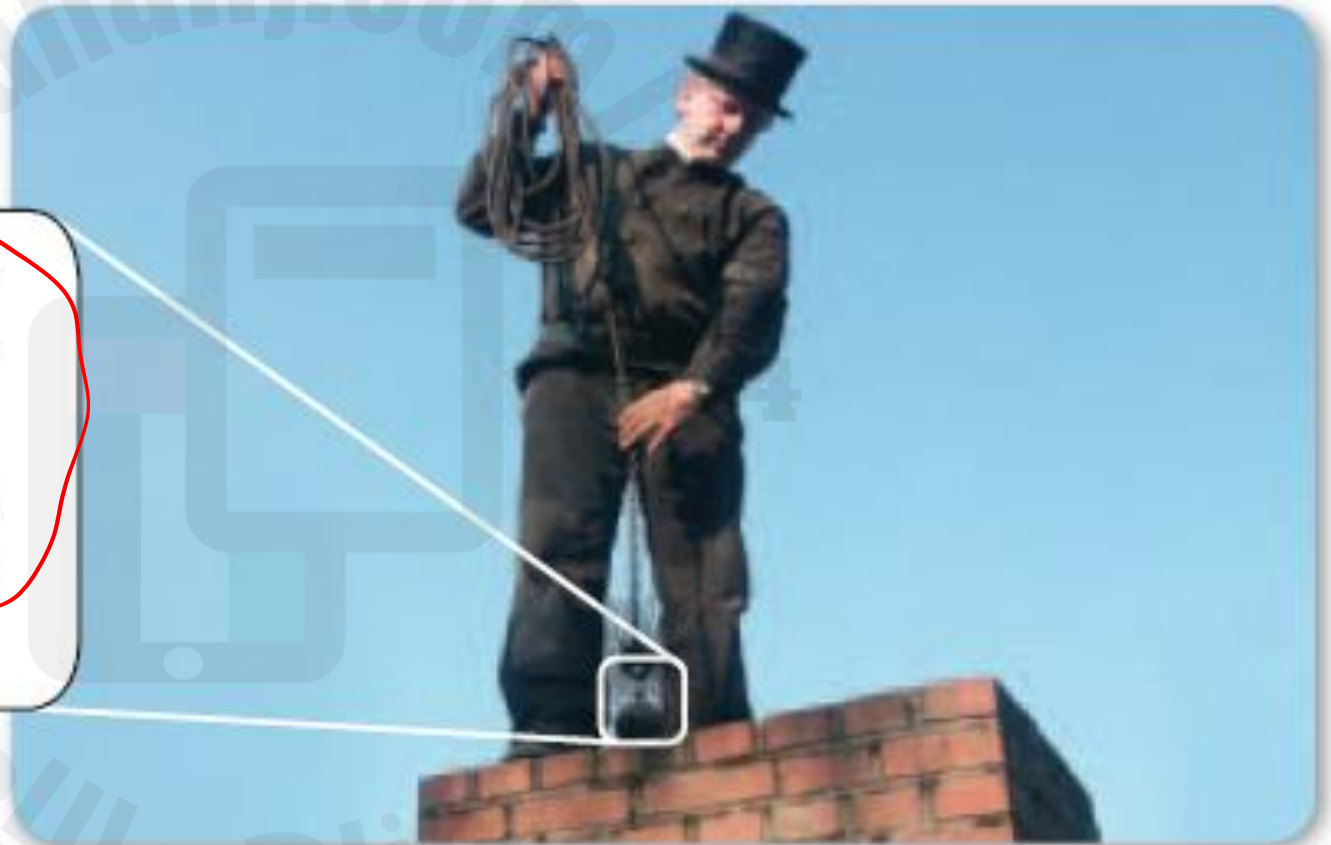
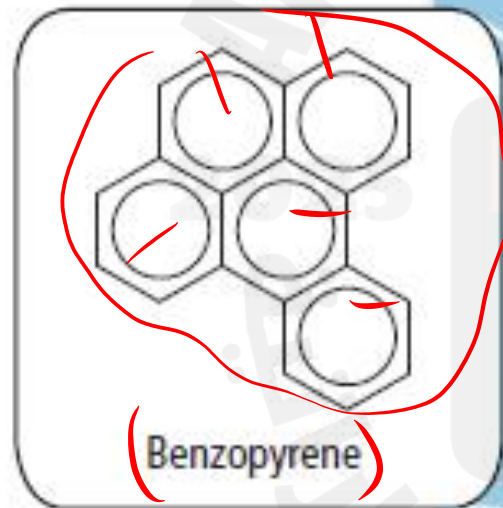
# *benzene* Aromatic Compounds

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- Many aromatic compounds, such as toluene, benzene, and xylene, were once commonly used as industrial and laboratory solvents.
- Their use has been limited due to health risks linked to regular exposure.
- These risks include respiratory ailments, liver problems, and nervous system damage.
- Some aromatic compounds are also carcinogens.

# Carcinogens: benzopyrene

■ **Figure** Benzopyrene is a cancer-causing chemical that is found in soot, cigarette smoke, and car exhaust.





# Learning Outcomes:

- ▶ **Compare and contrast** the properties of aromatic and aliphatic hydrocarbons.
- ▶ **Explain** what a carcinogen is and list some examples.



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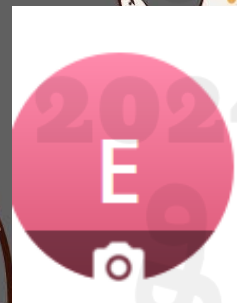
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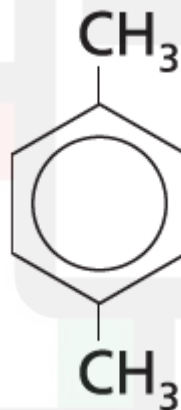
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# Plenary

**Challenge** Draw the structure of 1,4-dimethylbenzene.



**Both are correct**



## Quiz

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5. What best explains why extra care should be taken when using some aromatic compounds, such as toluene, benzene, and xylene?

- ☐ A They are very expensive.
- ☒ B They pose serious health risks.
- ☐ C They are very explosive.
- ☐ D None of the above.

# Aromatic Compounds

---

- Many aromatic compounds, such as toluene, benzene, and xylene, were once commonly used as industrial and laboratory solvents.
- Their use has been limited due to health risks linked to regular exposure.
- These risks include respiratory ailments, liver problems, and nervous system damage.
- Some aromatic compounds are also carcinogens.