Unit 15 · Aromatic Hydrocarbons

WORKSHEET

Full marks 33

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 33

1 True or false [3]

Write True or False in the box beside each sentence. Correct each false sentence. Each carries 0.5 mark.

i. Benzene decolorizes bromine water at once, like an alkene. ☐

ii. Benzene melts at 5.5 °C, so it can freeze on a cold winter morning. ☐

iii. Cycloheptatriene is aromatic because it has 6 π electrons. ☐

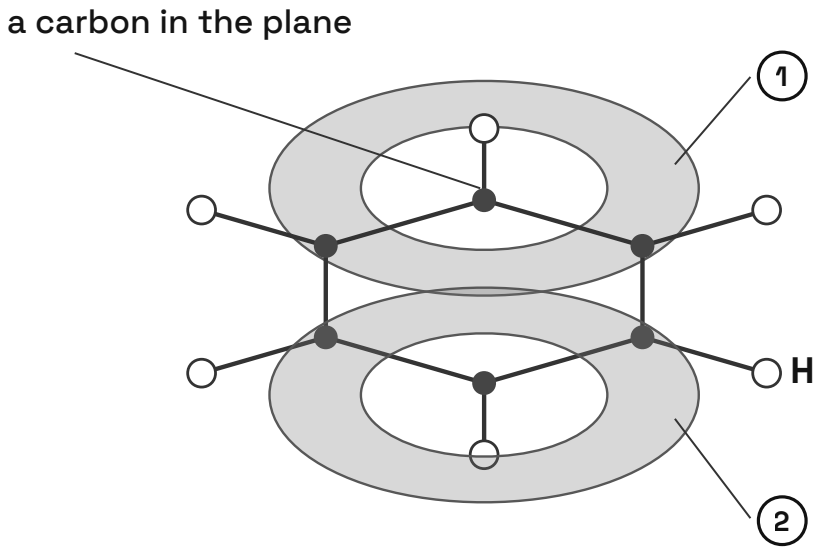
iv. The electrophile in the nitration of benzene is the nitronium ion, NO_2^+. ☐

v. Benzene and chlorine in sunlight give chlorobenzene. ☐

vi. A nitro group on the ring sends the next group to the ortho and para positions. ☐

2 Label the diagram [1]

The diagram shows the π electrons of benzene. Write what belongs in place of 1 and 2. Each carries 0.5 mark.



1. _____ **2.** _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. By Hückel's rule, which of these rings is aromatic? [1]

a. cyclobutadiene **b.** cyclopentadiene

c. furan **d.** cycloheptatriene

ii. How many isomers does dichlorobenzene, $C_6H_4Cl_2$, have? [1]

a. 1 **b.** 2

c. 3 **d.** 6

iii. Benzene heated with ethanoic anhydride and anhydrous $AlCl_3$ gives: [1]

a. toluene and ethanoic acid **b.** acetophenone and ethanoic acid

c. ethylbenzene and water **d.** acetophenone and HCl

iv. The $-NH_2$ group of aniline is: [1]

a. an ortho–para director and a ring activator

b. an ortho–para director and a ring deactivator

c. a meta director and a ring activator

d. a meta director and a ring deactivator

v. Benzene is nitrated with the nitrating mixture at about 100 °C instead of 50–60 °C. The main product is: [1]

a. nitrobenzene **b.** 1,2-dinitrobenzene

c. 1,3-dinitrobenzene **d.** 1,4-dinitrobenzene

4 Short answers [9]

Write short answers to the following questions.

a. Benzene is drawn with three double bonds. Why does it take part in substitution reactions more readily than in addition? [2]

b. Write two facts that Kekulé's structure, with fixed single and double bonds, cannot explain. [2]

c. Write balanced equations for the reaction of benzene with chlorine i. in the dark with $FeCl_3$, and ii. in sunlight. Name the type of each reaction. [2]

d. State Hückel's rule. Use it to show that cyclobutadiene, C_4H_4, a flat ring with two C=C, is not aromatic. **[3]**

5 Long answer **[4]**

Write a long answer to the following question.

Describe the nitration of benzene: the reagents and conditions, how the electrophile forms, and the two steps by which it substitutes the ring. Write equations.

6 Numerical problems **[8]**

Solve the following problems. Show your working. Take C = 12, H = 1, N = 14, O = 16, Na = 23, the density of benzene as 0.877 g/cm^3 and the molar volume of a gas at STP as 22.4 L.

a. 7.2 g of sodium benzoate, C_6H_5COONa, is heated with soda-lime. i. Write the equation. ii. Find the mass and the volume of benzene formed, if the reaction is complete. iii. Find the mass of sodium carbonate formed. **[4]**

Answer:

b. 13.44 L of ethyne, measured at STP, is passed through a red-hot iron tube, and all of it forms benzene. The benzene is then nitrated, with a yield of 75%. i. Write the two equations. ii. Find the mass of benzene formed. iii. Find the mass of nitrobenzene obtained. **[4]**

Answer: _____

7 Think [3]

The –Cl group sends the next group to the ortho and para positions, yet chlorobenzene reacts more slowly than benzene with electrophiles. Explain both facts.

8 Activity: Two flames (at home, with an adult) (not marked)

You need: a candle, a gas stove, a steel spoon held with a cloth or tongs, and an adult beside you. Hold the back of the spoon for three seconds in the yellow tip of the candle flame, then wipe it and hold it for three seconds just above the blue flame of the gas stove. Let the spoon cool before you touch it.

	Candle flame	Gas stove flame
Color of the flame		
What is left on the spoon		

Which of the two flames is like the flame of burning benzene, and why does benzene burn that way?