11.4 Arenes

Set A **Foundations**

Name	Time 1 hour	Total 36 marks	Score ____ / 36

A Data Booklet may be used.

A From the lesson

13 MARKS

1 COMMON Give the reagents and conditions to make each compound from benzene.

(a) bromobenzene

.....

[1]

(b) ethylbenzene

.....

[1]

/2

Source: Learners' Alley, Arenes slides

2 CHALLENGE Write the equation that forms the electrophile in question 1(a).

.....

[1]

/1

Source: Learners' Alley, Arenes slides

3 COMMON Methylbenzene reacts with Br_2. Give the conditions and organic product for

(a) substitution on the ring

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.....

[2]

(b) substitution on the side chain

.....

.....

[2]

/4

Source: Learners' Alley, Arenes slides

4 Why does benzene undergo substitution, not addition?

.....

.....

[1]

/1

Source: Learners' Alley, Arenes slides

5 What is the electrophile in nitration, and how is it formed?

.....

.....

[2]

/2

Source: Learners' Alley, Arenes slides

6 Why is methylbenzene nitrated faster than benzene?

.....

.....

[2]

/2

Source: Learners' Alley, Arenes slides

7 Why doesn't tert-butylbenzene react with hot acidified $KMnO_4$?

.....

[1]

/1

Source: Learners' Alley, Arenes slides

B Practice

23 MARKS

8 COMMON In the reaction represented by the equation $C_6H_6 + Cl_2 \rightarrow C_6H_5Cl + HCl$, what type of reaction has benzene undergone?

A electrophilic addition

B electrophilic substitution

C free radical substitution

D nucleophilic addition

E nucleophilic substitution

Answer [1]

/1

Source: A Level 1993 P4 Q21, via EJC Arenes Topical Quiz, Q5

9 The molecule of benzene, C_6H_6, is a regular hexagon in which the π electrons are described as delocalised. Which of the following statements support this structure?

1 Benzene is a good conductor of electricity.
2 Addition reactions of benzene take place more easily than substitution.
3 All C–C bond lengths in benzene are intermediate between the C–C bond in an alkane and the C=C bond in an alkene.
4 The enthalpy change of hydrogenation of benzene is less exothermic than that predicted for cyclohexatriene.

A 1 and 3 **B** 3 and 4 **C** 1, 2 and 3 only **D** 1, 2 and 4 only

Answer [ ] [1]

/1

Source: SRJC 2017 Prelim P1 Q22, via EJC Arenes Topical Revision, Q4

10 A comparison is made of the nitration reactions of some aromatic compounds. How will the reaction temperatures required compare?

	lowest		highest
A	benzoic acid	benzene	phenylamine
B	phenylamine	benzene	ethylbenzene
C	phenylamine	ethylbenzene	benzaldehyde
D	benzoic acid	benzaldehyde	ethylbenzene

Answer [ ] [1]

/1

Source: DHS 2017 Prelim P1 Q18, via EJC Arenes Topical Revision, Q9

11 **(a)** COMMON State the reagents and conditions needed to convert benzene into (i) chlorobenzene, (ii) bromobenzene, (iii) nitrobenzene.

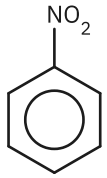
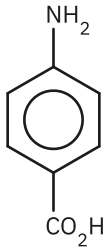
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..... **[3]**

(b) The nitration of benzene is a two-step reaction: $C_6H_6 + A^+ \rightarrow B \rightarrow C_6H_5NO_2 + H^+$. Identify the cation A^+.

..... **[1]**

(c) The position of substitution during the electrophilic substitution of arenes is determined by the nature of the group already attached to the ring. Suggest a likely structure for the organic product of each reaction: (i) bromination of  (ii) chlorination of 

[2]

16

Source: A Level 2004 P4 Q5, via EJC Arenes Topical Quiz, Q2

12 Describe a simple chemical test to distinguish the following pairs of compounds. State your observations and give balanced equations for the reactions involved.

(a) benzene and methylbenzene

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.....

..... **[2]**

(b) benzene and cyclohexane

.....

.....

..... **[2]**

14

Source: EJC 2022 JC1 Arenes Tutorial, Section B Q5(a) and (b)

13 COMMON BrCl reacts with benzene in the presence of $AlCl_3$ in an electrophilic substitution reaction to produce bromobenzene.

(a) Explain why bromobenzene is made in preference to chlorobenzene during the reaction.

.....

..... **[1]**

(b) Hence, draw the electrophilic substitution mechanism of the reaction.

[2]

/3

Source: 2025 NYJC J2 Prelim P3 QA1(c)(i) and (ii)

14 CHALLENGE Methylbenzene, $C_6H_5CH_3$, is required on a large scale as an industrially important organic compound, and is also added to high grade unleaded petrol.

(a) Write an equation for the combustion of methylbenzene.

.....

[1]

(b) Methylbenzene is manufactured by passing heptane, C_7H_{16}, vapour over a catalyst. In the process, there is one gaseous by-product. Construct an equation for this process, showing the structural formulae of the organic molecules.

.....

[1]

(c) The reaction is endothermic. Explain what conditions of temperature would favour a high equilibrium yield.

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[2]

(d) Use the equation in (b) to explain what conditions of pressure would favour a high equilibrium yield.

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[2]

(e) 1,4-dimethylbenzene can be oxidised to benzene-1,4-dicarboxylic acid. Using the [O] notation for the oxidation of organic compounds, write a balanced equation for this oxidation.

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[1]

/7

Source: A Level 1997 P2 Q5 (a) to (d) and (f), via EJC Arenes Topical Quiz, Q4