Chemistry A H034/434 - GCE

Test Name: Benzene Lesson 1

Test Duration (minutes): 44

Test Created By: Kate Critchley

Number of questions in test: 4

Candidate forename:		Candidate surname:	

INSTRUCTIONS TO CANDIDATES

- Answer **all** questions
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answers to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.

Question: 1

A chemist was investigating the reactions of benzene, phenol and cyclohexene with bromine.
She found that they all reacted with bromine but under different conditions.

(a) The chemist found that when benzene reacts with bromine, a halogen carrier is required as a
catalyst.

Write an equation for this reaction.
You do **not** need to show the halogen carrier in your equation.

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[1]

(b) The chemist also found that when phenol or cyclohexene reacts with bromine, a halogen
carrier is **not** required.

(i) The chemist observed that bromine decolourises when it reacts with phenol.

What other observation would she have made?

Draw the structure of the organic product formed.
Observation .....

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Organic product:

[2]

(ii) Cyclohexene also decolourises bromine.
Name the organic product formed.

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[1]

(iii) Explain the relative resistance to bromination of benzene compared to phenol and
compared to cyclohexene.

In your answer, you should use appropriate technical terms, spelt correctly.

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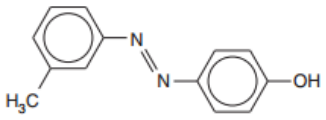
[5]

(c) Compound **A**, shown below, is being considered as an azo dye by a chemical company. A
chemist planned a two-stage synthesis of compound **A** starting from an aromatic amine.



compound A

The aromatic amine is first converted into a diazonium ion.

- Draw the displayed formula of the aromatic amine **and** of the diazonium ion.

- State the reagents and conditions for each stage in the synthesis of

compound **A** from
an aromatic amine.

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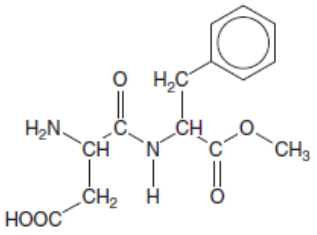
[5]

[Total: 14]

Question: 2

The addition of sucrose, table sugar, to food and drink has been linked to the increased risk of obesity and insulin resistance. Aspartame is used as an alternative to sugar.

The structure of aspartame is shown below.



aspartame

(a) Aspartame contains five functional groups including the benzene ring, and has two chiral carbon atoms.

(i) Circle the **two** chiral carbon atoms on the structure above.

[1]

(ii) Name the **four** functional groups, other than the benzene ring, in aspartame.

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[2]

(b) Aspartame consumed in food or drink might be hydrolysed by the acid in the stomach. This acid consists mainly of hydrochloric acid.

Draw the structures of the **three** organic products formed by the **complete** acid hydrolysis of aspartame.

[4]

(c) Some artificial sweeteners commonly available many years ago have now been withdrawn from use.

Suggest why.

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[1]

[Total: 8]

Question: 3

Benzene is an important industrial chemical and is used in a wide range of manufacturing processes. Over time our understanding of the structure and bonding of benzene has changed and various models have been proposed.

(a) In 1865, Kekulé proposed a model for the structure and bonding of benzene, but there is considerable evidence to suggest that Kekulé's model may not be correct. Scientists have proposed alternative models for the structure and bonding of benzene.

Explain the evidence that led scientists to doubt the model proposed by Kekulé.

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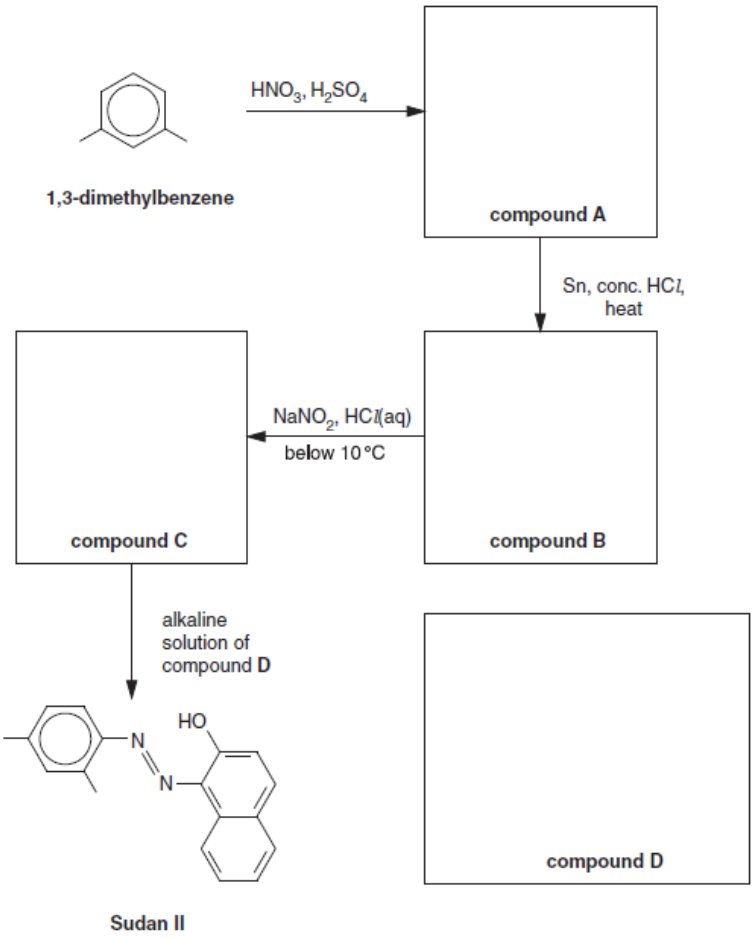
[3]

(b) Sudan II is an azo dye which was used as a colourant in chilli powder. However, scientists advised the Food Standards Agency that Sudan II was linked to an increased risk of cancer and it is now no longer used as a food colourant.

The flowchart below shows how Sudan II could be prepared in the laboratory from 1,3-dimethylbenzene.

(i) Draw the structures of the organic compounds **A, B, C** and **D** in the boxes below.
Display the functional group in compound **C**.



[4]

(ii) Compound **A** is formed by reacting 1,3-dimethylbenzene with HNO_3 and H_2SO_4.

Explain, with the aid of curly arrows, the mechanism for the formation of compound **A**.

Your answer should clearly show the role of H_2SO_4 as a catalyst.

[5]

(iii) Deduce how many **other** structural isomers of compound **A** could have been formed from the mononitration of 1,3-dimethylbenzene.

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[1]

[Total: 13]

Question: 4

Concentrated sulfuric acid reacts with many organic compounds, forming water as one of the products.
For example, sulfuric acid dehydrates ethanol by eliminating water to form ethene.

$$C_2H_5OH \rightarrow C_2H_4 + H_2O$$

In each part below, sulfuric acid is a dehydrating agent.
(a) Sulfuric acid dehydrates methanoic acid to form a gas, **G**, with the same molar mass as ethene.

Suggest the identity of **G** and write an equation for the reaction.

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[2]

(b) Sulfuric acid dehydrates sucrose, $C_{12}H_{22}O_{11}$, to form a black solid, **H**.

Suggest the identity of **H** and write an equation for the reaction.

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[2]

(c) Sulfuric acid dehydrates ethane-1,2-diol to form a compound **I** with a molar mass of 88 g mol^{-1}. In this reaction, two moles of ethane-1,2-diol produce one mole of **I** and two moles of H_2O.

Suggest the identity of **I**. Write an equation for the reaction and deduce the structural formula of compound **I**.

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[3]

[Total: 7]

Resource assets
Question(s): 1 2

General Information

- 1 mol of gas molecules occupies 24.0 dm^3 at room temperature and pressure, RTP.
- Avogadro constant, $N_A = 6.02 \times 10^{23}\ mol^{-1}$.
- Ionic product of water, $K_w = 1.00 \times 10^{-14}\ mol^2\ dm^{-6}$.

Characteristic infrared absorptions in organic molecules

bond	location	wavenumber/cm^{-1}
C—O	alcohols, esters, carboxylic acids	1000–1300
C=O	aldehydes, ketones, carboxylic acids, esters, amides	1640–1750
C—H	organic compound with a C—H bond	2850–3100
O—H	carboxylic acids	2500–3300 (very broad)
N—H	amines, amides	3200–3500
O—H	alcohols, phenols	3200–3550 (broad)

Resource assets
Question(s): 1 2

OCR
RECOGNISING ACHIEVEMENT

Data Sheet for Chemistry A

(version 2.0)

GCE Advanced Level and Advanced Subsidiary

Chemistry A (H034, H434)

Chemistry A units F321–F326

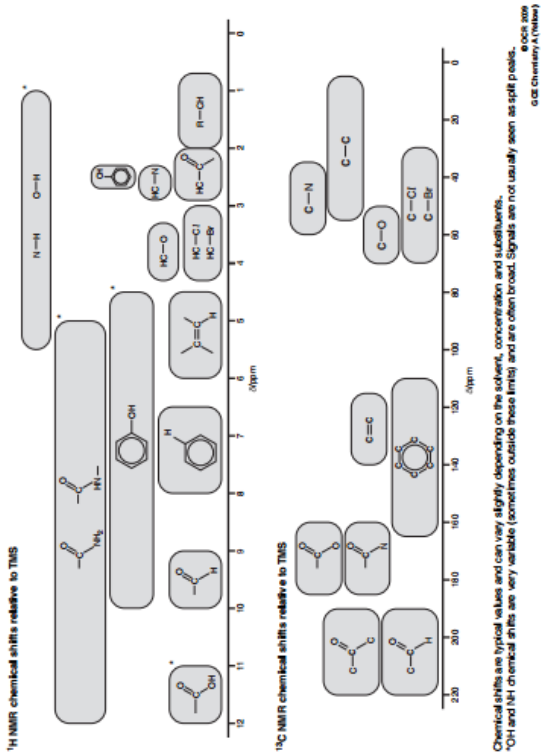
The information in this sheet is for the use of candidates following Chemistry A (H034 and H434).

Clean copies of this sheet must be issued to candidates in the examination room, and must be given up to the invigilator at the end of the examination.

Copies of this sheet may be used for teaching.

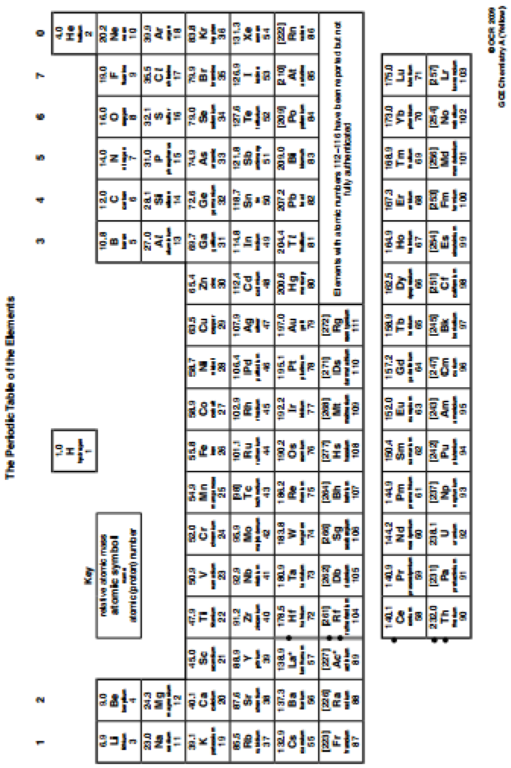
DC (SLM/SW) 15341/2

Resource assets
Question(s): 1 2



<u>Resource assets</u>

Question(s): 1 2



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