A LEVEL CHEMISTRY

TOPIC 18 – AROMATIC CHEMISTRY

TEST

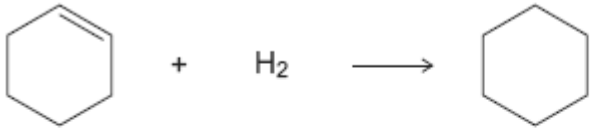
Answer all questions

Max 50 marks

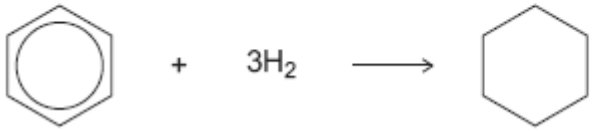
Name ……..
Mark ……../50 ……....% Grade ……

1. The hydrocarbons benzene and cyclohexene are both unsaturated compounds. Benzene normally undergoes substitution reactions, but cyclohexene normally undergoes addition reactions.

(a) The molecule cyclohexatriene does not exist and is described as hypothetical. Use the following data to state and explain the stability of benzene compared with the hypothetical cyclohexatriene.



$\Delta H^{\ominus} = -120\,kJ\,mol^{-1}$



$\Delta H^{\ominus} = -208\,kJ\,mol^{-1}$

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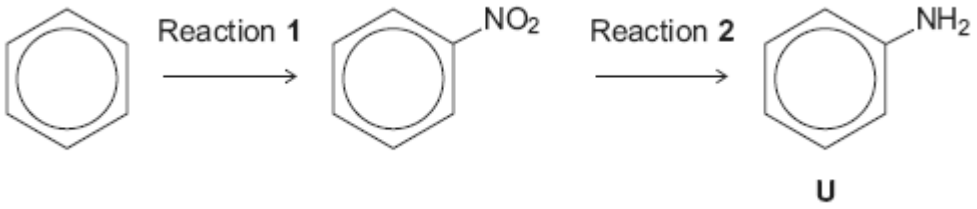
(4)

(b) Benzene can be converted into amine **U** by the two-step synthesis shown below.



U

The mechanism of Reaction **1** involves attack by an electrophile.

Give the reagents used to produce the electrophile needed in Reaction **1**.

Write an equation showing the formation of this electrophile.

Outline a mechanism for the reaction of this electrophile with benzene.

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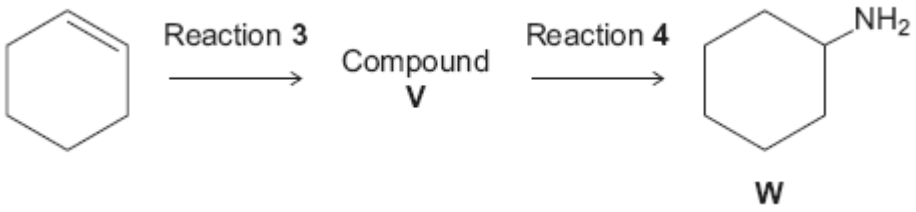
(6)

(c) Cyclohexene can be converted into amine **W** by the two-step synthesis shown below.



W

Suggest an identity for compound **V**.

For Reaction **3**, give the reagent used and name the mechanism.

For Reaction **4**, give the reagent and condition used and name the mechanism.

Equations and mechanisms with curly arrows are **not** required.

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(6)

(d) Explain why amine **U** is a weaker base than amine **W**.

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(3)
(Total 19 marks)

2. Give a reagent that could be used in a test-tube reaction to distinguish between benzene and cyclohexene.
Describe what you would see when the reagent is added to each compound and the test tube is shaken.

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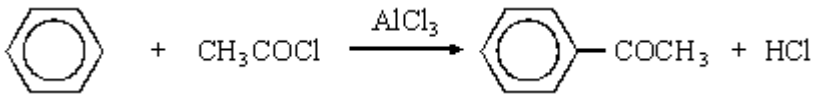
(3)
(Total 3 marks)

3. An equation for the formation of phenylethanone is shown below. In this reaction a reactive intermediate is formed from ethanoyl chloride. This intermediate then reacts with benzene.



(i) Give the formula of the reactive intermediate.

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(ii) Outline a mechanism for the reaction of this intermediate with benzene to form phenylethanone.

(4)
(Total 4 marks)

4. (a) Outline a mechanism for the formation of ethylamine from bromoethane. State why the ethylamine formed is contaminated with other amines. Suggest how the reaction conditions could be modified to minimise this contamination.

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(6)

(b) Suggest one reason why phenylamine cannot be prepared from bromobenzene in a similar way. Outline a synthesis of phenylamine from benzene. In your answer you should give reagents and conditions for each step, but equations and mechanisms are not required.

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(5)
(Total 11 marks)

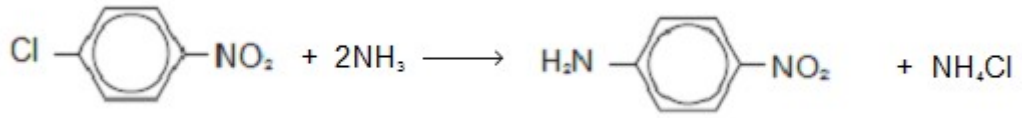
5. Kevlar is a polymer used in protective clothing.

One of the monomers used in the synthesis of Kevlar is



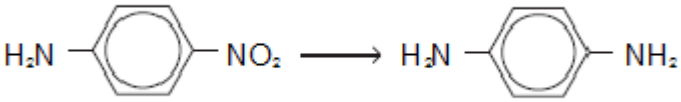
An industrial synthesis of this monomer uses the following two-stage process starting from compound **X**.

Stage **1**



X

Stage **2**



(a) Suggest why the reaction of ammonia with **X** in Stage **1** might be considered unexpected.

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(2)

(b) Suggest a combination of reagents for the reaction in Stage **2**.

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(1)

(c) Compound **X** can be produced by nitration of chlorobenzene.

Give the combination of reagents for this nitration of chlorobenzene. Write an equation or equations to show the formation of a reactive intermediate from these reagents.

Reagents .....

.....

Equation(s) .....

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(3)

(d) Name and outline a mechanism for the formation of **X** from chlorobenzene and the reactive intermediate in part (iii).

Name of mechanism .....

Mechanism

(4)
(Total 10 marks)

6. Which one of the following does **not** contain any delocalised electrons?

A poly(propene)

B benzene

C graphite

D sodium

(Total 1 mark)

7. The relative molecular mass (M_r) of benzene-1,4-dicarboxylic acid is

A 164

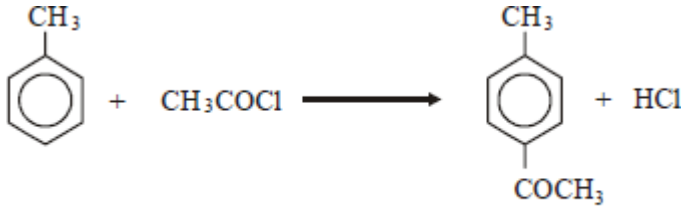
B 166

C 168

C 170

(Total 1 mark)

8. Ethanoyl chloride reacts with methylbenzene forming compound **X** according to the equation below.



X

If the experimental yield is 40.0%, the mass in grams of **X** (M_r = 134.0) formed from 18.4 g of methylbenzene (M_r = 92.0) is

A 26.8

B 16.1

C 10.7

D 7.4

(Total 1 mark)