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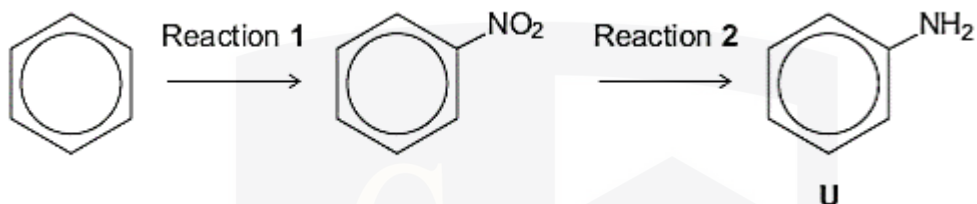
INORGANIC CHEMISTRY II

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|-----------------|--------------------|
| Level & Board | AQA (A-LEVEL) |
| TOPIC: | AROMATIC CHEMISTRY |
| PAPER TYPE: | QUESTION PAPER - 3 |
| TOTAL QUESTIONS | 10 |
| TOTAL MARKS | 59 |

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Aromatic Chemistry - 3

1. Benzene can be converted into amine U by the two-step synthesis shown below.



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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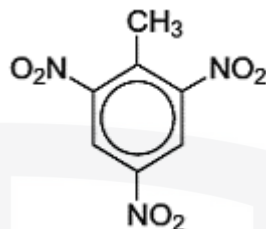
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2. Many aromatic nitro compounds are used as explosives.

One of the most famous is 2-methyl-1,3,5-trinitrobenzene, originally called trinitrotoluene or TNT.

This compound, shown below, can be prepared from methylbenzene by



a sequence of nitration reactions.

(a) The mechanism of the nitration of methylbenzene is an electrophilic substitution.

Give the reagents used to produce the electrophile for this reaction.

Write an equation or equations to show the formation of this electrophile.

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(3)

(b) Outline a mechanism for the reaction of this electrophile with methylbenzene to produce 4-methylnitrobenzene.

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(3)

(c) Deduce the number of peaks in the ^1H n.m.r. spectrum of TNT.

(1)

(d) Using the molecular formula ($\text{C}_7\text{H}_5\text{N}_3\text{O}_6$), write an equation for the decomposition reaction that occurs on the detonation of TNT.

In this reaction equal numbers of moles of carbon and carbon monoxide are formed together with water and nitrogen.

(1)

3. Consider the reaction of propanal with HCN.

(a) Write an equation for the reaction of propanal with HCN and name the product.

(2)

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(b) Name and outline a mechanism for the reaction of propanal with HCN

(5)

4. Outline a synthesis of phenylamine from benzene.

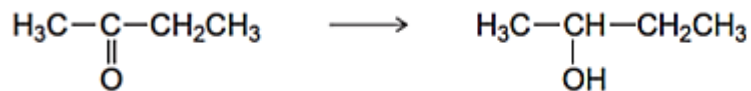
In your answer you should give reagents and conditions for each step, but equations and mechanisms are not required.

Suggest one reason why phenylamine cannot be prepared from bromobenzene in a similar way.

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(5)

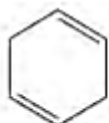
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5. The reducing agent in the following conversion is NaBH_4



Name and outline a mechanism for the reaction.

(5)

6. The structures of two cyclic dienes are shown.



cyclohexa-1,4-diene



cyclohexa-1,3-diene

(a) Use the enthalpy of hydrogenation data given opposite to calculate a value for the enthalpy of hydrogenation of cyclohexa-1,4-diene.

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(1)

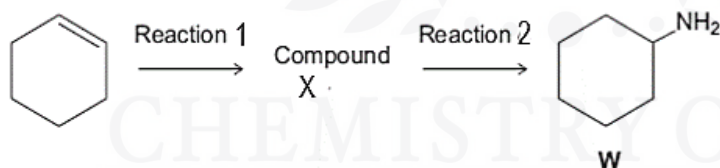
(b) Predict a value for the enthalpy of hydrogenation of cyclohexa-1,3-diene.

(1)

(c) Explain your answers in terms of the bonding in these two dienes.

(3)

7. Cyclohexene can be converted into amine W by the two-step synthesis shown below.



Suggest an identity for compound X.

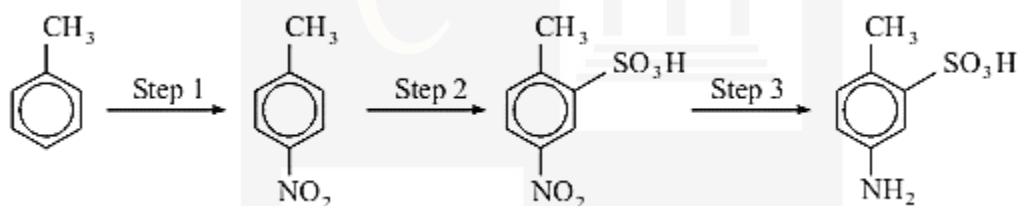
For Reaction 1, give the reagent used and name the mechanism.

For Reaction 2, give the reagent and condition used and name the mechanism.

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(5)

8. 5-Amino-2-methylbenzenesulphonic acid can be obtained from methylbenzene in a three-step synthesis:



- (a) For each step below, name the type of reaction taking place and suggest a suitable reagent or combination of reagents.

(4)

- (b) Write an equation for the formation of the reactive inorganic species involved in the mechanism in Step 1.

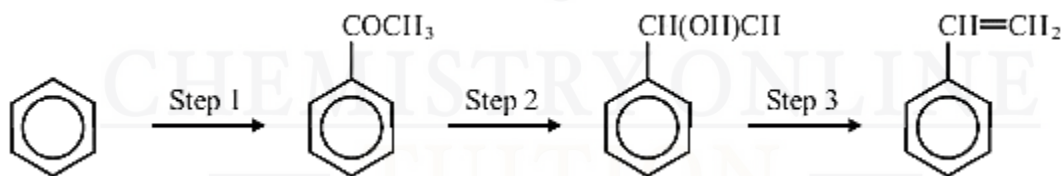
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9. Give the reagents required to form nitrobenzene from benzene.

Name the mechanism involved and write an overall equation for the reaction.

(4)

10. In the laboratory, phenylethene can be obtained from benzene in a three-step synthesis:



(a) Give the organic reagent and the inorganic catalyst used in Step 1.

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(2)

(b) Name the type of reaction taking place in Step 2.

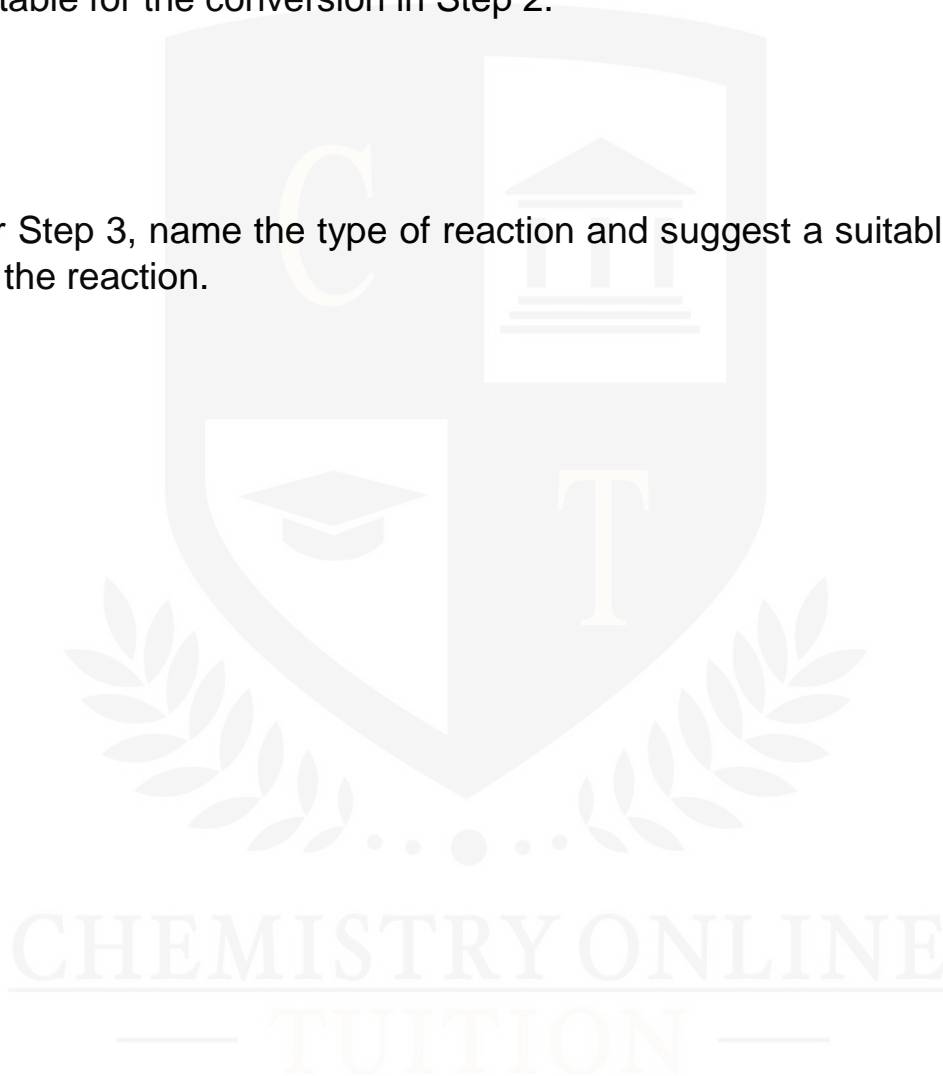
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(c) Suggest either a reagent or a combination of reagent and catalyst suitable for the conversion in Step 2.

(2)

(d) For Step 3, name the type of reaction and suggest a suitable reagent for the reaction.

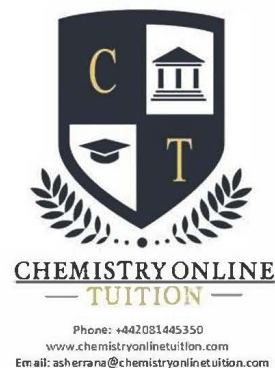
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