CHEMISTRY ONLINE
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CHEMISTRY

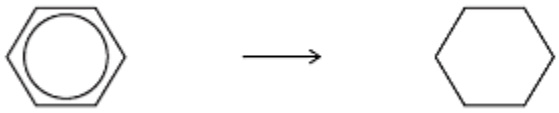
ORGANIC CHEMISTRY II

Level & Board	AQA (A-LEVEL)
TOPIC:	AROMATIC CHEMISTRY
PAPER TYPE:	SOLUTION - 4
TOTAL QUESTIONS	10
TOTAL MARKS	49

Aromatic Chemistry – 4

1.

Reducing Agent for Benzene to Cyclohexane Conversion:



- The reduction of benzene to cyclohexane can be achieved using **hydrogen gas (H_2)** in the presence of a suitable catalyst such as **nickel (Ni)** or **platinum (Pt)**.

Empirical Formula of the Product:

- The empirical formula of cyclohexane is **CH_2** .

Bond Angles:

- In benzene, the bond angle between the carbon atoms is **120°**.
- In cyclohexane, the bond angle between the carbon atoms is approximately 109.5°.

(4)

2.

(a)

To form the acylium ion $H_3C-C^+=O$ from ethanoyl chloride (CH_3COCl), a common reagent used is aluminum chloride ($AlCl_3$).

The balanced equation for this reaction is:

$CH_3COCl + AlCl_3 \rightarrow H_3C-C^+=O + AlCl_4^-$

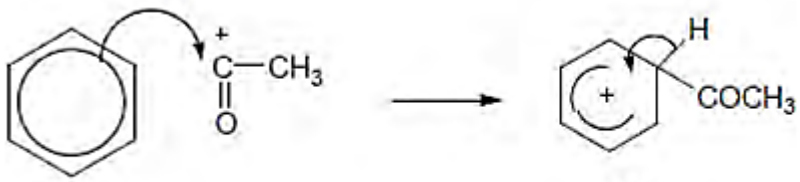
(2)

(b)

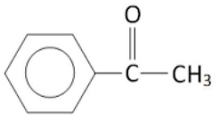
Name of the mechanism:

Electrophilic substitution (Friedel crafts)

Mechanism:



Product:



(4)

3.

(a)

The electrophile formed by the reaction of benzene typically involves the use of propanoyl chloride (CH_3CH_2COCl), also known as propionyl chloride, in the presence of a Lewis acid catalyst such as $AlCl_3$ or FeCl3.

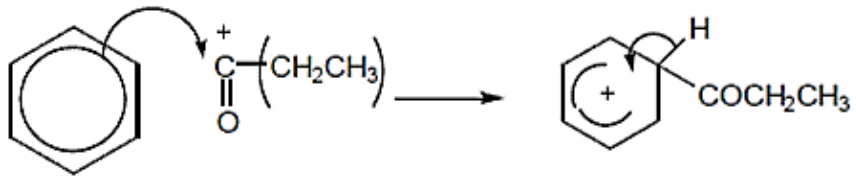
The equation to show the formation of the electrophile is:

$$CH_3CH_2COCl + AlCl_3 \rightarrow CH_3CH_2CO^+ + AlCl_4^-$$

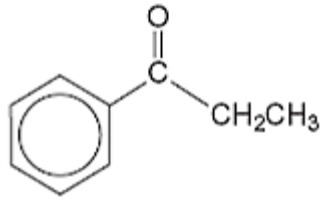
(3)

(b)

Mechanism:



Product:



(3)

4.

(a)

Equation for the overall reaction:

$C_6H_6 + HNO_3 \rightarrow C_6H_5NO_2 + H_2O$

(1)

(b)

The catalyst used: (concentrated) sulphuric acid

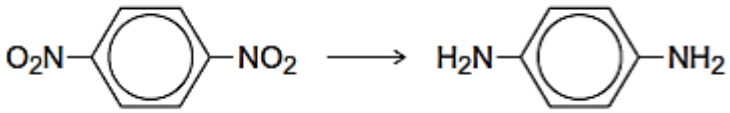
(1)

(c)

The electrophile involved in the reaction: NO_2^+

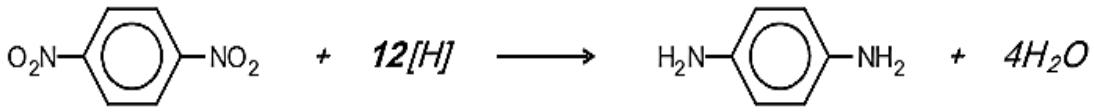
(1)

5.

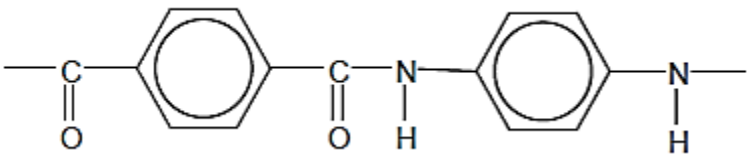


Reducing agents and conditions:

- **Tin and HCl:**
  - **Reagents:** Tin (Sn) and Hydrochloric acid (HCl)
  - **Conditions:** Reflux
- **Hydrogen gas with Nickel/Palladium Catalyst:**
  - **Reagents:** Hydrogen gas (H2), Nickel (Ni) or Palladium (Pd) catalyst
  - **Conditions:** Under high pressure and temperature, typically with the catalyst at room temperature or slightly elevated.
- **Balance equation for this reaction using molecular formulae:**
- $C_6H_4N_2O_4 + 12\ [H] \rightarrow C_6H_8N_2 + 4H_2O$



Repeating unit:



(5)

6.

(a)

The economic importance of cracking is that it satisfies market demand for smaller, unsaturated molecules such as alkenes, and other valuable products like gasoline.

This process helps in producing high-demand products that are more profitable.

(1)

(b)

Balanced equation:

$C_{14}H_{30} \rightarrow C_2H_4 + C_{12}H_{26}$

(1)

(c)

Removing sulfur compounds from fuels is crucial to reduce the emission of sulfur oxides, which contribute to acid rain formation.

Acid rain harms ecosystems, corrodes infrastructure, and affects agricultural productivity.

Therefore, it is important that as many as possible of the sulphur compounds are removed from fuels obtained from oil.

(1)

7.

(a)

Name compound X: $((CH_3)_2CHCN)$

2-methylpropanenitrile

(1)

(b)

To form X from C_3H_7Br, the **reagent** is KCN (potassium cyanide), and the **conditions** are alcoholic or aqueous.

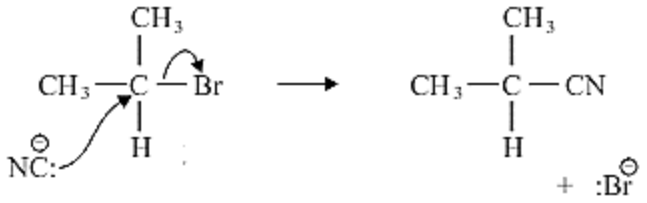
(2)

(c)

Name of mechanism:

Nucleophilic substitution

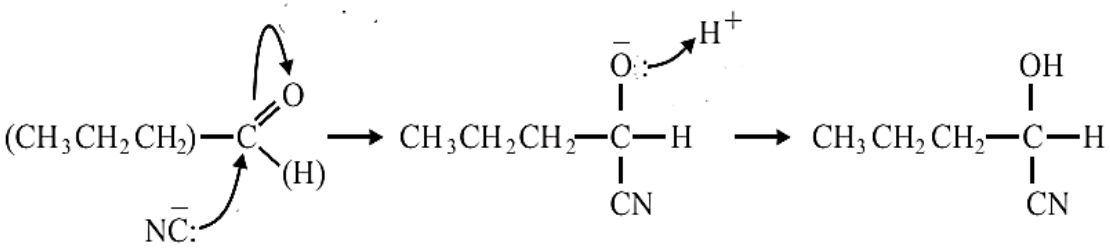
Mechanism:



(4)

8.

Mechanism:



Name of the product:

2-hydroxypenta(ne/o)nitrile

Or 1-cyanobutan-1-ol

(5)

9.

(a)

Name the compound $(CH_3)_2NH$: dimethylamine

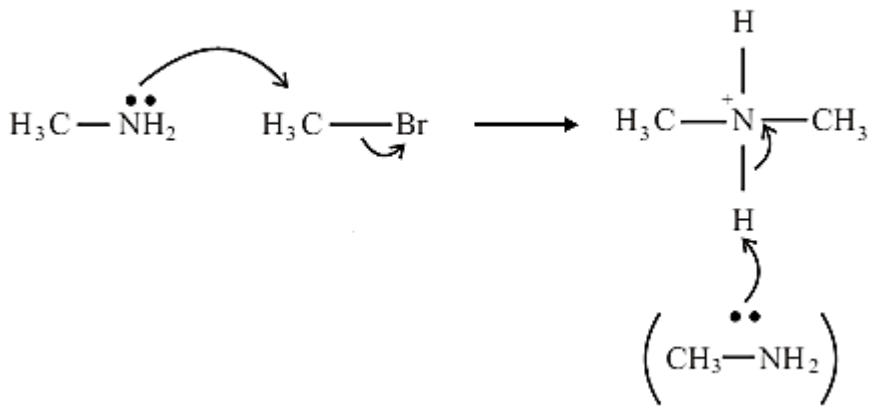
(1)

(b)

Name of mechanism:

Nucleophilic substitution

Mechanism:



Product:

$(CH_3)_2NH$

(5)

10.

(a)

$C_6H_5CH_3 + Cl_2 \rightarrow C_6H_5CH_2Cl + HCl$

Equation for the initiation step:

$Cl_2 \rightarrow 2Cl^{\cdot}$

(1)

(b)

Equations for the two propagation steps:

$Cl^{\cdot} + C_6H_5CH_3 \rightarrow C_6H_5CH_2^{\cdot} + HCl$

$C_6H_5CH_2^{\cdot} + Cl_2 \rightarrow Cl^{\cdot} + C_6H_5CH_2Cl$

(2)

(c)

Following are other possible organic product of the reaction:

$C_6H_5CHCl_2$ / $C_6H_5CCl_3$ / $C_6H_5CHCHC_6H_5$

(1)

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