

Name of the Student: _____

Max. Marks : 28 Marks

Time : 28 Minutes

Q1.

The nitration of benzene uses a nitrating mixture of concentrated nitric acid and concentrated sulfuric acid.



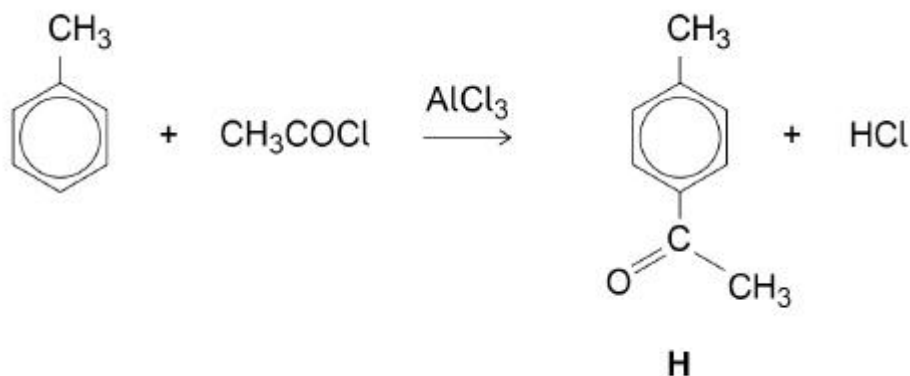
Which statement is correct?

- A HNO_3 acts as a base. ☐
- B HNO_3 acts as a catalyst. ☐
- C HNO_3 acts as an electrophile. ☐
- D HNO_3 acts as a reducing agent. ☐

(Total 1 mark)

Q2.

When methylbenzene reacts with ethanoyl chloride in the presence of aluminium chloride, the product, **H**, is formed.



- (a) Deduce the molecular formula of **H**.

(1)

- (b) Two other isomers are also produced in the reaction.

Draw the structure of **one** of the other isomers.

Name the type of structural isomerism shown by these three products.

Structure

Type of isomerism _____

(2)

- (c) Name and outline the mechanism for the reaction of ethanoyl chloride with methylbenzene to produce **H**.

Include an equation for the formation of the reactive intermediate that is involved in the reaction.

Name _____

Equation _____

Mechanism

Q3.

Use your understanding of the bonding in benzene to identify the compound that has the most exothermic enthalpy of hydrogenation.

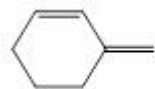
A



B



C



D

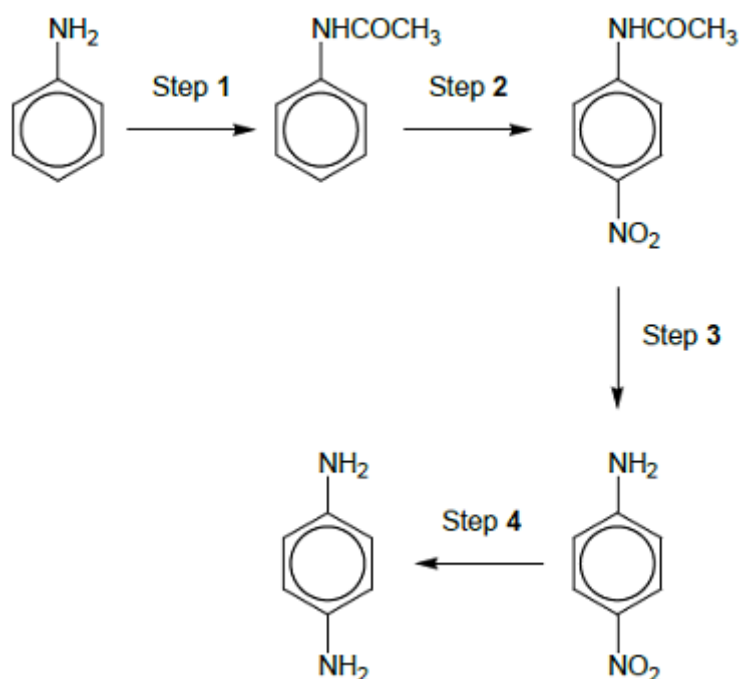


(Total 1 mark)

Q4.

1,4-diaminobenzene is an important intermediate in the production of polymers such as Kevlar and also of polyurethanes, used in making foam seating.

A possible synthesis of 1,4-diaminobenzene from phenylamine is shown in the following figure.



- (a) A suitable reagent for step 1 is CH_3COCl

Name and draw a mechanism for the reaction in step 1.

Name of mechanism _____

Mechanism

(5)

- (b) The product of step 1 was purified by recrystallisation as follows.

The crude product was dissolved in **the minimum quantity of hot water** and the hot solution was filtered through a hot filter funnel into a conical flask. This filtration removed any insoluble impurities. The flask was **left to cool to room temperature**.

The crystals formed were filtered off using a Buchner funnel and a clean cork was used **to compress the crystals in the funnel. A little cold water was then poured through the crystals**.

After a few minutes, the crystals were removed from the funnel and weighed.

A small sample was then used to find the melting point.

Give reasons for each of the following practical steps.

The minimum quantity of hot water was used

The flask was cooled to room temperature before the crystals were filtered off

The crystals were compressed in the funnel

A little cold water was poured through the crystals

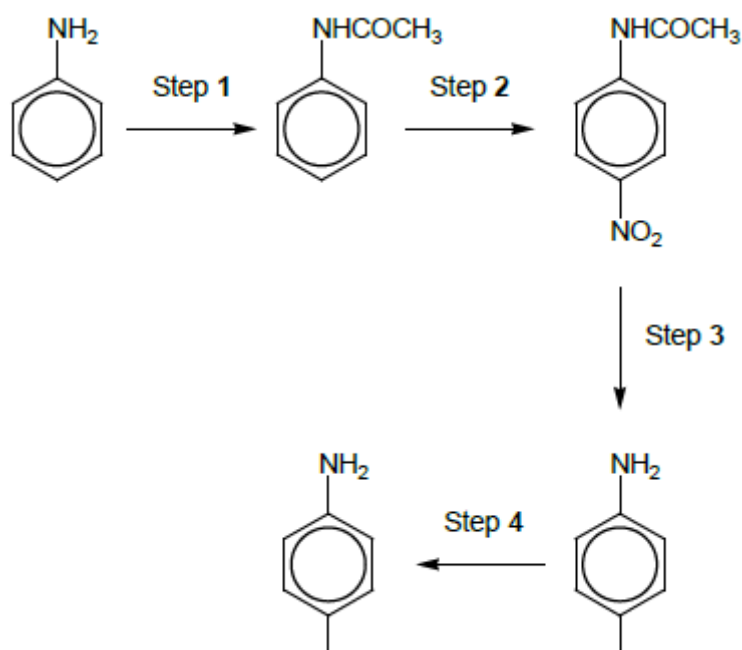
(4)

- (c) The melting point of the sample in part (b) was found to be slightly lower than a data-book value.

Suggest the most likely impurity to have caused this low value and an improvement to the method so that a more accurate value for the melting point would be obtained.

(2)

The figure above is repeated here to help you answer the following questions.



- (d) In an experiment starting with 5.05 g of phenylamine, 4.82 g of purified product were obtained in step 1.

Calculate the percentage yield in this reaction.
Give your answer to the appropriate number of significant figures.

Percentage yield = _____ %

(3)

- (e) A reagent for step 2 is a mixture of concentrated nitric acid and concentrated sulfuric acid, which react together to form a reactive intermediate.

Write an equation for the reaction of this intermediate in step 2.

(1)

- (f) Name a mechanism for the reaction in step 2.

(1)

- (g) Suggest the type of reaction occurring in step 3.

(1)

(h) Identify the reagents used in step 4.

(1)

(Total 18 marks)