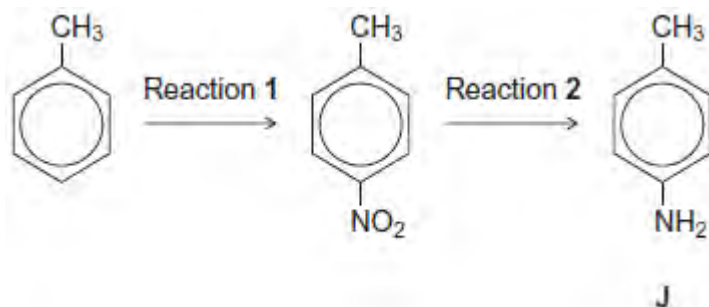


Q1. Consider the following reaction sequence starting from methylbenzene.



(a) Name the type of mechanism for reaction 1.

.....

(1)

(b) Compound **J** is formed by reduction in reaction 2.

(i) Give a reducing agent for this reaction.

.....

(1)

(ii) Write an equation for this reaction. Use [H] to represent the reducing agent.

.....

(1)

(iii) Give a use for **J**.

.....

(1)

(c) Outline a mechanism for the reaction of bromomethane with an excess of compound **J**.

You should represent **J** as RNH_2 in the mechanism.

(4)

(d) Compound **K** ($C_6H_5CH_2NH_2$) is a structural isomer of **J**.

Explain why **J** is a weaker base than **K**.

.....

.....

.....

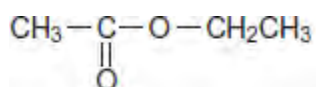
.....

.....

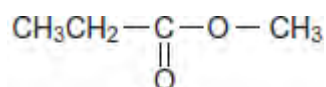
.....

(3)
(Total 11 marks)

Q2.(a) Ester 1 and Ester 2 were studied by 1H n.m.r. spectroscopy.

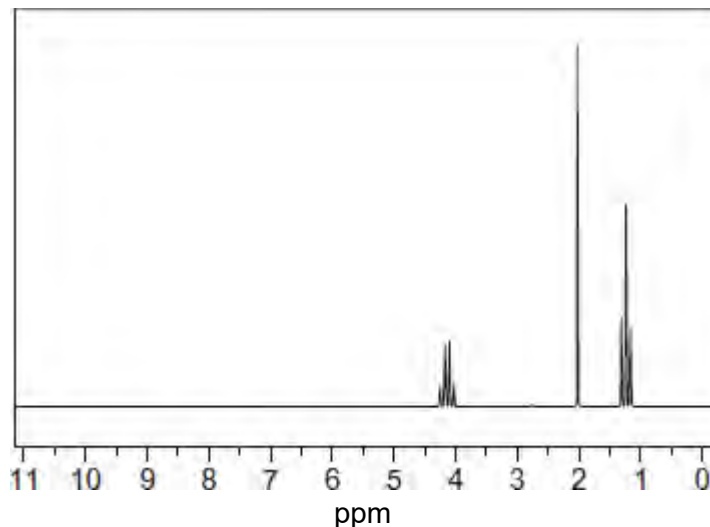


Ester 1



Ester 2

One of the two esters produced this spectrum.



Deduce which of the two esters produced the spectrum shown. In your answer, explain the position and splitting of the quartet peak at $\delta = 4.1$ ppm in the spectrum.

Predict the δ value of the quartet peak in the spectrum of the other ester.

Use **Table B** on the Data Sheet.

.....

.....

.....

.....

.....

.....

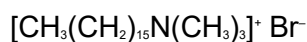
.....

.....

.....

(4)

(b) Cetrimide is used as an antiseptic.



cetrimide

Name this type of compound.

Give the reagent that must be added to $\text{CH}_3(\text{CH}_2)_{15}\text{NH}_2$ to make cetrimide and state the reaction conditions.

Name the type of mechanism involved in this reaction.

.....

.....

.....

.....

.....

.....

.....

.....

(4)

- (c) 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.

.....

.....

.....

.....

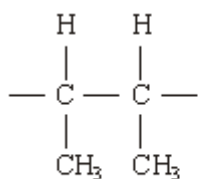
.....

.....

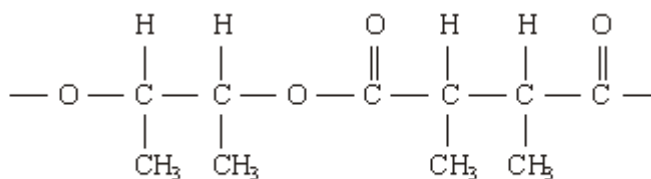
.....

(3)
(Total 11 marks)

Q3. (a) The repeating units of two polymers, **P** and **Q**, are shown below.



P



Q

- (i) Draw the structure of the monomer used to form polymer **P**. Name the type of polymerisation involved.

Structure of monomer

Type of polymerisation

- (ii) Draw the structures of **two** compounds which react together to form polymer **Q**. Name these **two** compounds and name the type of polymerisation involved.

Structure of compound 1

Name of compound 1

Structure of compound 2

Name of compound 2

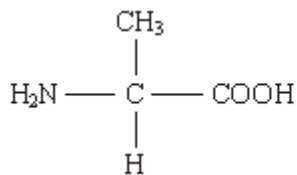
Type of polymerisation

- (iii) Identify a compound which, in aqueous solution, will break down polymer **Q** but not polymer **P**.

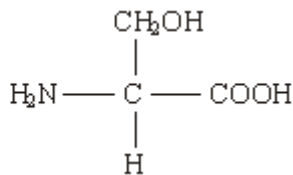
.....

(8)

- (b) Draw the structures of the **two** dipeptides which can form when one of the amino acids shown below reacts with the other.



Structure 1



Structure 2

(2)

(c) Propylamine, $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$, can be formed either by nucleophilic substitution or by reduction.

(i) Draw the structure of a compound which can undergo nucleophilic substitution to form propylamine.

(ii) Draw the structure of the nitrile which can be reduced to form propylamine.

(iii) State and explain which of the two routes to propylamine, by nucleophilic substitution or by reduction, gives the less pure product. Draw the structure of a compound formed as an impurity.

Route giving the less pure product

Explanation

.....

Structure of an impurity

(5)
(Total 15 marks)

Q4. This question is about the primary amine $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$

(a) The amine $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$ reacts with CH_3COCl

Name and outline a mechanism for this reaction.

Give the IUPAC name of the organic product.

.....
.....

(6)

(b) Isomers of $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$ include another primary amine, a secondary amine and a tertiary amine.

(i) Draw the structures of these **three** isomers.
Label each structure as primary, secondary or tertiary.

(3)

- (ii) Use **Table 1** on the Data Sheet to explain how you could use infrared spectra in the range outside the fingerprint region to distinguish between the secondary amine and the tertiary amine.

.....
.....
.....
.....
.....

(2)

- (c) The amine $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$ can be prepared by two different routes.

Route **A** is a two-stage process and starts from $\text{CH}_3\text{CH}_2\text{Br}$.

Route **B** is a one-stage process and starts from $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$.

- (i) Identify the intermediate compound in Route **A**.

Give the reagents and conditions for both stages in Route **A** and the single stage in Route **B**.

.....
.....
.....
.....
.....
.....
.....
.....

.....
.....
.....
.....
.....
.....
.....

(7)

(ii) Give **one** disadvantage of Route **A** and **one** disadvantage of Route **B**.

.....
.....
.....
.....

(2)

(Total 20 marks)