

Q1. A chemist has discovered that the labels have fallen off four bottles each of which contains a different organic liquid. These liquids are known to be propan-2-ol, propanal, hexene and 1-bromopropane.

Suggest a series of test-tube reactions which a chemist could use to confirm the identities of the four compounds. State the reagents used and the observations expected.

(Total 10 marks)

Q2. (a) Name and outline a mechanism for the formation of butylamine, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$, by the reaction of ammonia with 1-bromobutane, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$.

Name of mechanism

Mechanism

(5)

(b) Butylamine can also be prepared in a two-step synthesis starting from 1-bromopropane, $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$. Write an equation for each of the two steps in this synthesis.

Step 1

.....

Step 2

.....

(3)

(c) (i) Explain why butylamine is a stronger base than ammonia.

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(ii) Identify a substance that could be added to aqueous butylamine to produce a basic buffer solution.

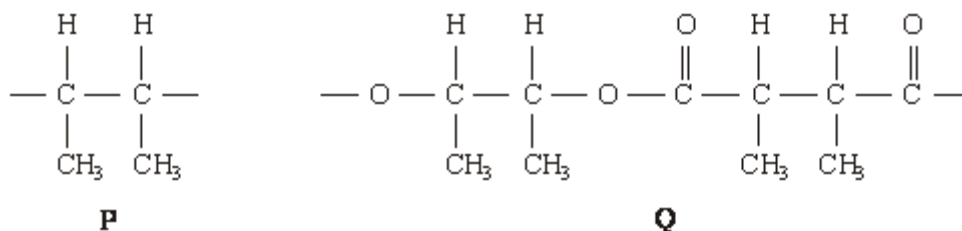
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(3)

(d) Draw the structure of a tertiary amine which is an isomer of butylamine.

(1)
(Total 12 marks)

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



(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

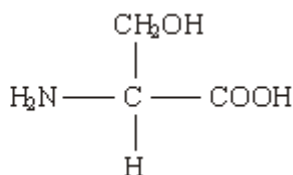
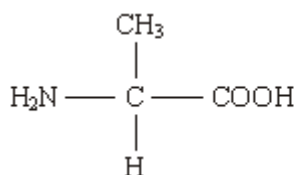
Type of polymerisation

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

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(8)

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



(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

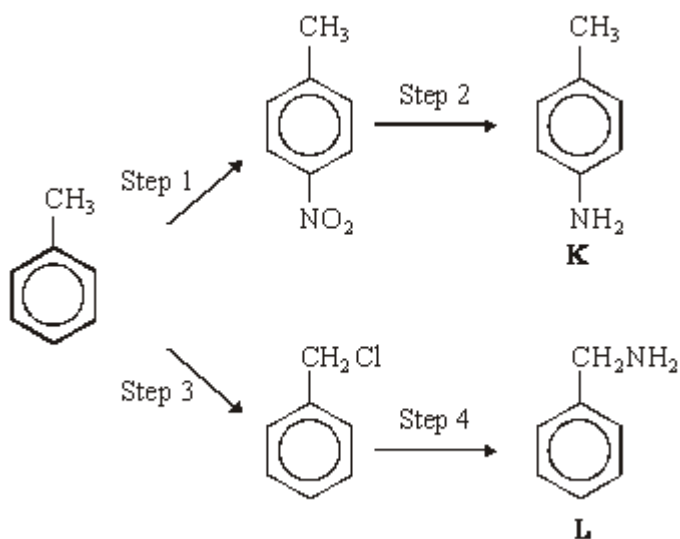
Explanation

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Structure of an impurity

(5)
(Total 15 marks)

Q4. The following reaction scheme shows the formation of two amines, **K** and **L**, from methylbenzene.



- (a) (i) Give the reagents needed to carry out Step 1. Write an equation for the formation from these reagents of the inorganic species which reacts with methylbenzene.

Reagents

Equation

- (ii) Name and outline a mechanism for the reaction between this inorganic species and methylbenzene.

Name of mechanism

Mechanism

- (b) Give a suitable reagent or combination of reagents for Step 2.

(7)

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(1)

- (c) (i) Give the reagent for Step 4 and state a condition to ensure that the primary amine is the major product.

Reagent

Condition

- (ii) Name and outline a mechanism for Step 4.

Name of mechanism

Mechanism

(7)
(Total 15 marks)