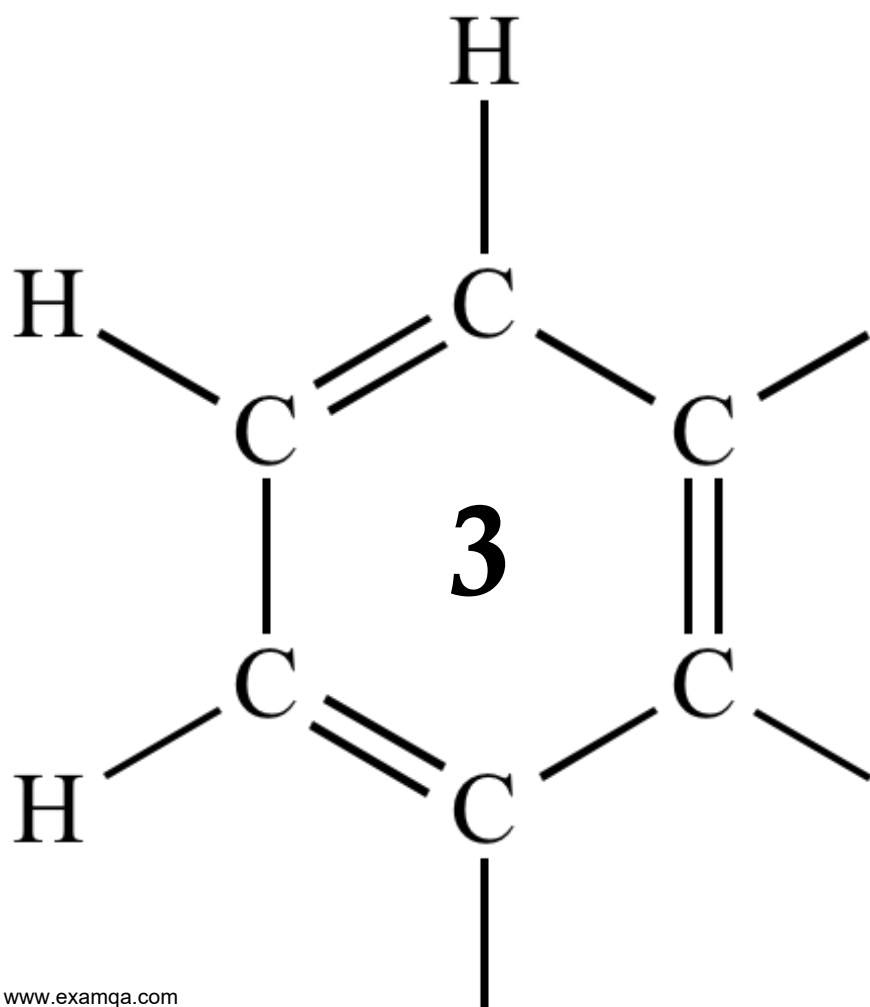


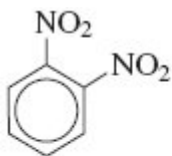
AQA A2 CHEMISTRY  
**AROMATIC ~ AMINES**

AMINES

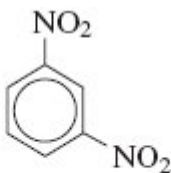


1

Three isomers of  $C_6H_4(NO_2)_2$  are shown below.



W



X



Y

- (a) (i) Give the number of peaks in the  $^{13}C$  n.m.r. spectrum of each isomer.

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.....  
.....

(3)

- (ii) Draw the displayed formula of the compound used as a standard in recording these spectra.

(1)

- (b) Isomer **X** is prepared from nitrobenzene by reaction with a mixture of concentrated nitric acid and concentrated sulfuric acid.

The two acids react to form an inorganic species that reacts with nitrobenzene to form **X**.

- (i) Give the formula of this inorganic species formed from the two acids and write an equation to show its formation.

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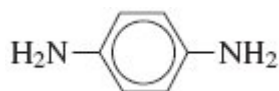
(2)

- (ii) Name and outline a mechanism for the reaction of this inorganic species with nitrobenzene to form **X**.

(4)

- (c) Isomer **Y** is used in the production of the polymer Kevlar.

**Y** is first reduced to the diamine shown below.



- (i) Identify a suitable reagent or mixture of reagents for the reduction of **Y** to form this diamine. Write an equation for this reaction using [H] to represent the reducing agent.

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

(2)

- (ii) This diamine is then reacted with benzene-1, 4-dicarboxylic acid to form Kevlar. Draw the repeating unit of Kevlar.

(2)

- (iii) Kevlar can be used as the inner lining of bicycle tyres. The rubber used for the outer part of the tyre is made of polymerised alkenes.

State the difference in the biodegradability of Kevlar compared to that of rubber made of polymerised alkenes.

Use your knowledge of the bonding in these polymer molecules to explain this difference.

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(4)  
(Total 18 marks)

2

- (a) Name and outline a mechanism for the reaction of  $\text{CH}_3\text{CH}_2\text{NH}_2$  with  $\text{CH}_3\text{CH}_2\text{COCl}$

Name the amide formed.

(6)

(b) Haloalkanes such as  $\text{CH}_3\text{Cl}$  are used in organic synthesis.

Outline a three-step synthesis of  $\text{CH}_3\text{CH}_2\text{NH}_2$  starting from methane. Your first step should involve the formation of  $\text{CH}_3\text{Cl}$

In your answer, identify the product of the second step and give the reagents and conditions for each step.

Equations and mechanisms are **not** required.

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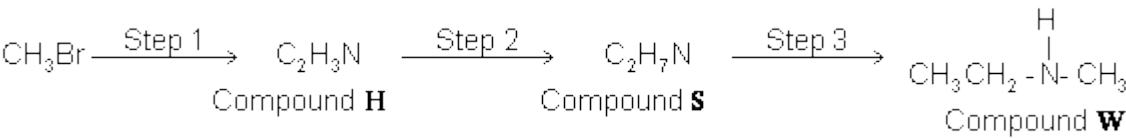
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(6)  
(Total 12 marks)

3

Compound **W** can be formed via compounds **H** and **S** in the three-step synthesis shown below.



Identify compounds **H** and **S** and give reagents and conditions for Steps 1 and 2.

State the **type** of compound of which **W** is an example.

**W** reacts with a large excess of bromomethane to form a solid product. Draw the structure of this product and name the type of mechanism for this reaction.

(Total 9 marks)

4

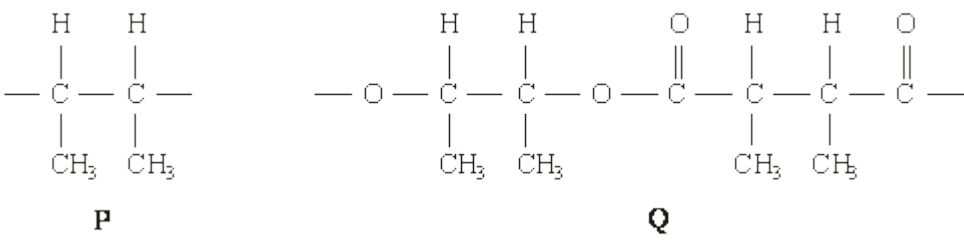
A chemist has discovered that the labels have fallen off four bottles each of which contains a different organic liquid. These liquids are known to be propan-2-ol, propanal, hexene and 1-bromopropane.

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)

5

(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* .....

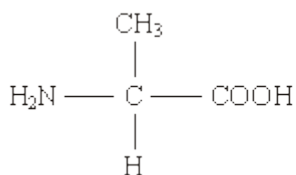
*Type of polymerisation* .....

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

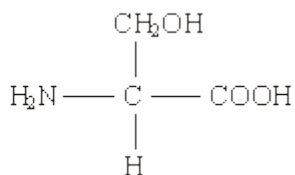
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**(8)**

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



*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)

6

- (a) Name the compound  $(\text{CH}_3)_2\text{NH}$

.....

(1)

- (b)  $(\text{CH}_3)_2\text{NH}$  can be formed by the reaction of an excess of  $\text{CH}_3\text{NH}_2$  with  $\text{CH}_3\text{Br}$ . Name and outline a mechanism for this reaction.

*Name of mechanism* .....

*Mechanism*

(5)

- (c) Name the type of compound produced when a large excess of  $\text{CH}_3\text{Br}$  reacts with  $\text{CH}_3\text{NH}_2$ . Give a use for this type of compound.

*Type of compound* .....

*Use* .....

(2)



- (d) Draw the structures of the two compounds formed in the reaction of  $\text{CH}_3\text{NH}_2$  with ethanoic anhydride.

(2)  
(Total 10 marks)