



# **A-Level Chemistry**

## **Amines**

### **Question Paper**

**Time available: 58 minutes**

**Marks available: 53 marks**

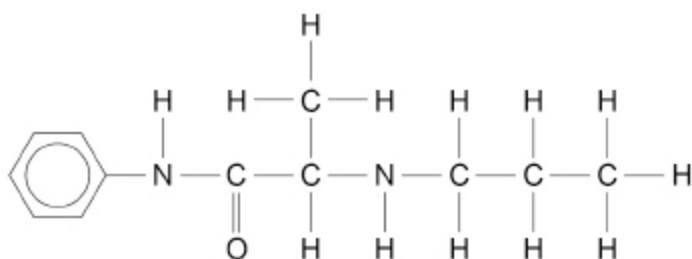
**[www.accesstuition.com](http://www.accesstuition.com)**

**1.**

Prilocaine is used as an anaesthetic in dentistry.

**Figure 1** shows the structure of prilocaine.

**Figure 1**



- (a) Draw a circle around any chiral centre(s) in **Figure 1**.

(1)

- (b) Identify the functional group(s) in the prilocaine molecule.

Tick (✓) the box(es) corresponding to the functional group(s).

Amide	Amine	Ester	Ketone
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(1)

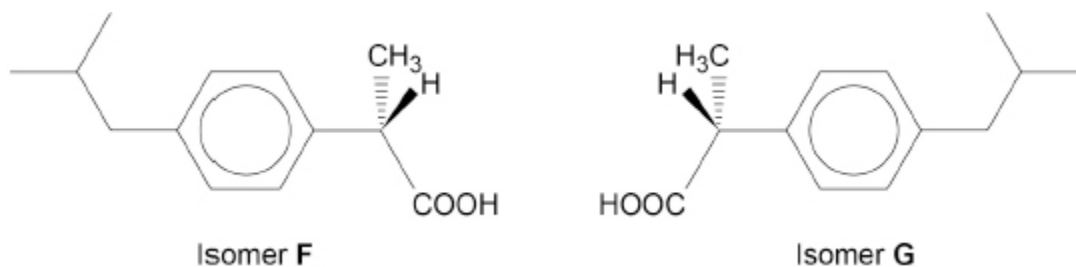
- (c) Prilocaine is completely hydrolysed in the human body to give a mixture of products.

Draw the structures of the two organic products formed in the complete hydrolysis of prilocaine in acidic conditions.

(3)

- (d) **Figure 2** shows optical isomers **F** and **G**.

**Figure 2**



Isomer **F** is the active compound in the medicine ibuprofen.

In the manufacture of ibuprofen both isomers **F** and **G** are formed. An enzyme is then used to bind to isomer **G** and catalyse its hydrolysis.

After the products of hydrolysis of **G** are removed, a pure sample of isomer **F** is collected.

Explain how a structural feature of this enzyme enables it to catalyse the hydrolysis of isomer **G** but not the hydrolysis of isomer **F**.

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(2)

(Total 7 marks)

2.

This question is about amines.

- (a) Give an equation for the preparation of 1,6-diaminohexane by the reaction of 1,6-dibromohexane with an excess of ammonia.

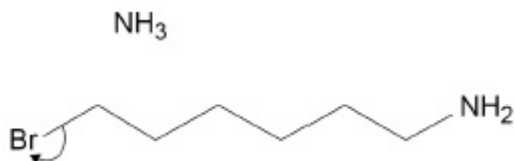
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(2)

- (b) Complete the mechanism for the reaction of ammonia with 6-bromohexylamine to form 1,6-diaminohexane.

Suggest the structure of a cyclic secondary amine that can be formed as a by-product in this reaction.

Mechanism



Cyclic secondary amine

(4)

- (c) 1,6-Diaminohexane can also be formed in a two-stage synthesis starting from 1,4-dibromobutane.  
Suggest the reagent and a condition for each stage in this alternative synthesis.

Stage 1 reagent and condition

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Stage 2 reagent and condition

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(3)

(d) Explain why 3-aminopentane is a stronger base than ammonia.

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(2)

(e) Justify the statement that there are no chiral centres in 3-aminopentane.

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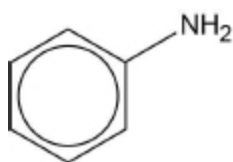
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(1)

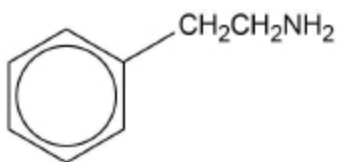
(Total 12 marks)

3.

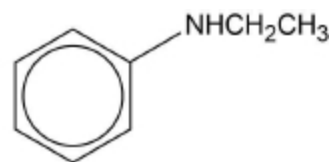
This question is about the three amines, **E**, **F** and **G**.



**E**



**F**



**G**

(a) Amines **E**, **F** and **G** are weak bases.

Explain the difference in base strength of the three amines and give the order of increasing base strength.

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(b) Amine **F** can be prepared in a three-step synthesis starting from methylbenzene.

Suggest the structures of the two intermediate compounds.

For each step, give reagents and conditions only. Equations and mechanisms are **not** required.

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(5)

(Total 11 marks)

4.

(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

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Step 2

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**(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)**

**5.**

- (a) Outline a mechanism for the formation of ethylamine from bromoethane. State why the ethylamine formed is contaminated with other amines. Suggest how the reaction conditions could be modified to minimise this contamination.

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**(6)**

- (b) Suggest one reason why phenylamine cannot be prepared from bromobenzene in a similar way. Outline a synthesis of phenylamine from benzene. In your answer you should give reagents and conditions for each step, but equations and mechanisms are not required.

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**(5)**

**(Total 11 marks)**