



A-Level Chemistry
Condensation Polymers
Question Paper

Time available: 60 minutes
Marks available: 59 marks

www.accesstuition.com

1.

(a) Synthetic polyamides are produced by the reaction of dicarboxylic acids with compounds such as $\text{H}_2\text{N}(\text{CH}_2)_6\text{NH}_2$

(i) Name the compound $\text{H}_2\text{N}(\text{CH}_2)_6\text{NH}_2$

(ii) Give the repeating unit in the polyamide nylon 6,6.

(2)

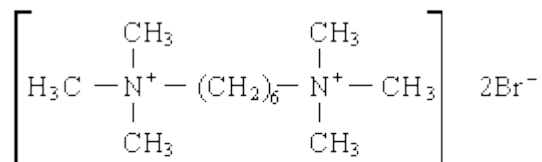
(b) Synthetic polyamides have structures similar to those found in proteins.

(i) Draw the structure of 2-aminopropanoic acid.

(ii) Draw the organic product formed by the condensation of two molecules of 2-aminopropanoic acid.

(2)

(c) Compounds like $\text{H}_2\text{N}(\text{CH}_2)_6\text{NH}_2$ are also used to make ionic compounds such as **X**, shown below.



Compound **X**

(i) **X** belongs to the same type of compound as $(\text{CH}_3)_4\text{N}^+\text{Br}^-$
Name this **type** of compound.

- (ii) State a reagent which could produce **X** from $\text{H}_2\text{N}(\text{CH}_2)_6\text{NH}_2$ and give a necessary condition to ensure that **X** is the major product.

Reagent _____

Condition _____

- (iii) Name the mechanism involved in this reaction to form **X**.

(4)

(Total 8 marks)

2.

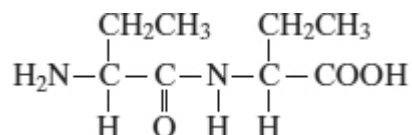
- (a) The compound $\text{H}_2\text{C}=\text{CHCN}$ is used in the formation of acrylic polymers.

- (i) Draw the repeating unit of the polymer formed from this compound.

- (ii) Name the type of polymerisation involved in the formation of this polymer.

(2)

- (b) When the dipeptide shown below is heated under acidic conditions, a single amino acid is produced.

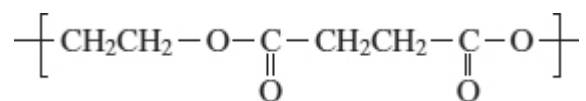


- (i) Name this amino acid.

- (ii) Draw the structure of the amino acid species present in the acidic solution.

(2)

(c) The repeating unit of a polyester is shown below.



(i) Deduce the empirical formula of the repeating unit of this polyester.

(ii) Draw the structure of the acid which could be used in the preparation of this polyester and give the name of this acid.

Structure _____

Name _____

(iii) Give **one** reason why the polyester is biodegradable.

(4)

(Total 8 marks)

3.

The amide or peptide link is found in synthetic polyamides and also in naturally occurring proteins.

(a) (i) Draw the repeating unit of the polyamide formed by the reaction of propanedioic acid with hexane-1,6-diamine.

(2)

- (ii) In terms of the intermolecular forces between the polymer chains, explain why polyamides can be made into fibres suitable for use in sewing and weaving, whereas polyalkenes usually produce fibres that are too weak for this purpose.

(3)

- (b) (i) Name and outline a mechanism for the reaction of $\text{CH}_3\text{CH}_2\text{COCl}$ with CH_3NH_2

Name of mechanism _____

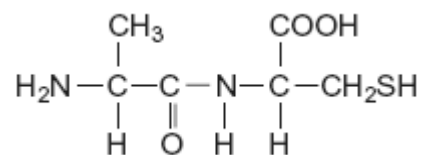
Mechanism

(5)

- (ii) Give the name of the product containing an amide linkage that is formed in the reaction in part (b) (i).

(1)

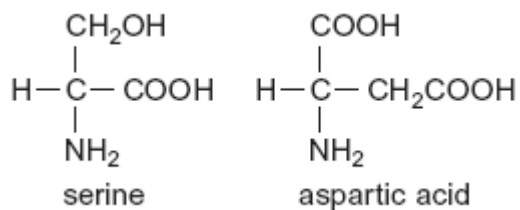
- (c) The dipeptide shown below is formed from two different amino acids.



Draw the structure of the alternative dipeptide that could be formed by these two amino acids.

(1)

- (d) The amino acids serine and aspartic acid are shown below.



- (i) Give the IUPAC name of serine.

(1)

- (ii) Draw the structure of the species formed when aspartic acid reacts with aqueous sodium hydroxide.

(1)

- (iii) Draw the structure of the species formed when serine reacts with dilute hydrochloric acid.

(1)

- (iv) Draw the structure of the species formed when serine reacts with an excess of bromomethane.

(1)

(Total 16 marks)

4.

Common substances used in everyday life often contain organic compounds.

- (a) State an everyday use for each of the following compounds.



(1)



(1)

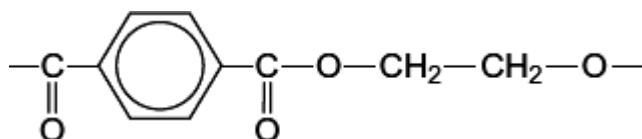


(1)

- (b) The following structures are the repeating units of two different condensation polymers.

For each example, name the type of condensation polymer. Give a common name for a polymer of this type.

- (i)

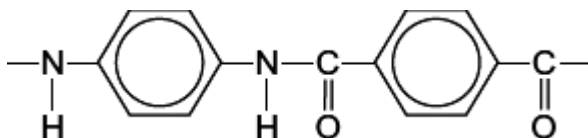


Type of condensation polymer _____

Common name _____

(2)

(ii)



Type of condensation polymer _____

Common name _____

(2)

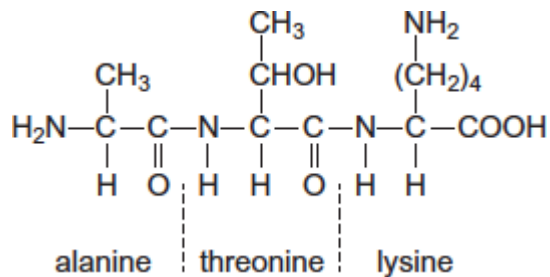
(iii) Explain why the polymer in part (b)(ii) has a higher melting point than the polymer in part (b)(i).

(2)

(Total 9 marks)

5.

(a) The tripeptide shown is formed from the amino acids alanine, threonine and lysine.



(i) Draw a separate circle around **each** of the asymmetric carbon atoms in the tripeptide.

(1)

(ii) Draw the zwitterion of alanine.

(1)

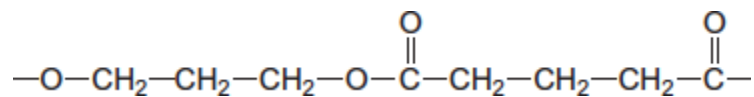
(iii) Give the IUPAC name of threonine.

(1)

(iv) Draw the species formed by lysine at low pH.

(1)

(b) The repeating unit shown represents a polyester.



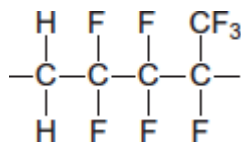
(i) Name this type of polymer.

(1)

(ii) Give the IUPAC name for the alcohol used to prepare this polyester.

(1)

(c) The repeating unit shown represents a polyalkene co-polymer. This co-polymer is made from two different alkene monomers.



(i) Name the type of polymerisation occurring in the formation of this co-polymer.

(1)

(ii) Draw the structure of each alkene monomer.

Alkene monomer 1

Alkene monomer 2

(2)

- (d) One of the three compounds shown in parts (a), (b) and (c) cannot be broken down by hydrolysis.

Write the letter **(a)**, **(b)** or **(c)** to identify this compound and explain why hydrolysis of this compound does **not** occur.

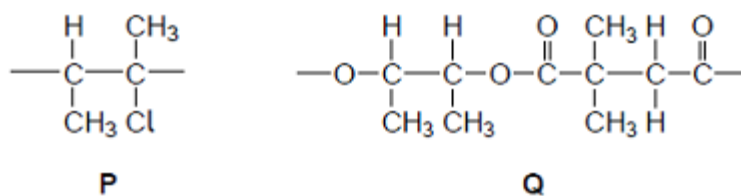
Compound _____

Explanation _____

(2)
(Total 11 marks)

6.

Repeating units of two polymers, **P** and **Q**, are shown in the figure below.



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

Monomer

Type of polymerisation

(2)

(b) Draw the structures of **two** compounds that react together to form polymer **Q**.

Structure of compound 1

Structure of compound 2

(2)

(c) Suggest an environmental advantage of polymer **Q** over polymer **P**.
Justify your answer.

Advantage _____

Justification _____

(3)

(Total 7 marks)