



## EXAM PAPERS PRACTICE

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Level: CIE AS and A Level (9701)

Subject: Chemistry

Topic: CIE Chemistry

Type: Topic Question

2002



1583

Chemistry CIE AS & A Level  
To be used for all exam preparation for 2025+

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# CHEMISTRY

# AS and A

This to be used by all students studying CIE AS and A level Chemistry (9701) But students of other boards may find it useful

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**Question 1.**

- (a) This question is about condensation polymers.

State the names of **two** classes of organic molecules that can take part in condensation polymerisation.

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(2 marks)

- (b) Draw the structure of the dicarboxylic acid whose formula is  $C_4H_6O_4$ . The functional groups should be displayed clearly.

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(1 mark)

- (c) State the IUPAC name of the dicarboxylic acid in part (b)

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(1 mark)

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- (d) Draw one repeat unit of the polymer formed when  $C_4H_6O_4$  polymerises with diethylamine,  $H_2NCH_2CH_2NH_2$ .

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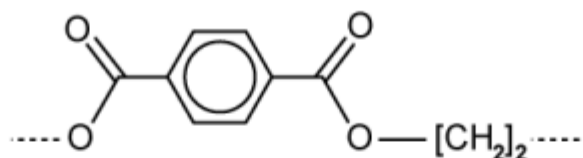
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(2 marks)



**Question 2.**

(a) The structure of a synthetic polyester is shown below.



Deduce the structures of **two monomers** used to make this polyester.

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(2 marks)

(b) One of the monomers is called benzene-1,4-dicarboxylic acid. State the name of the other one.

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(c) Name the other product of the reaction between the two monomers in part (b).

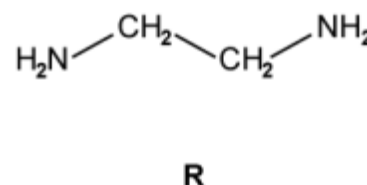
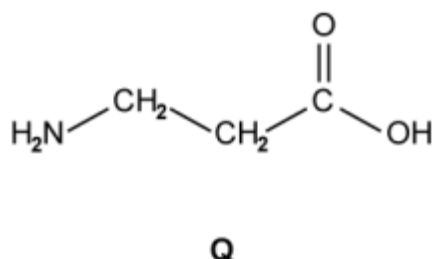
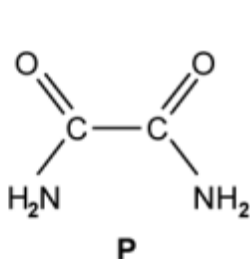
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(1 mark)

(d) Benzene-1,4-dicarboxylic acid will also react to form a polyamide.

Which of the three molecules could react with benzene-1,4-dicarboxylic acid to form a polyamide?



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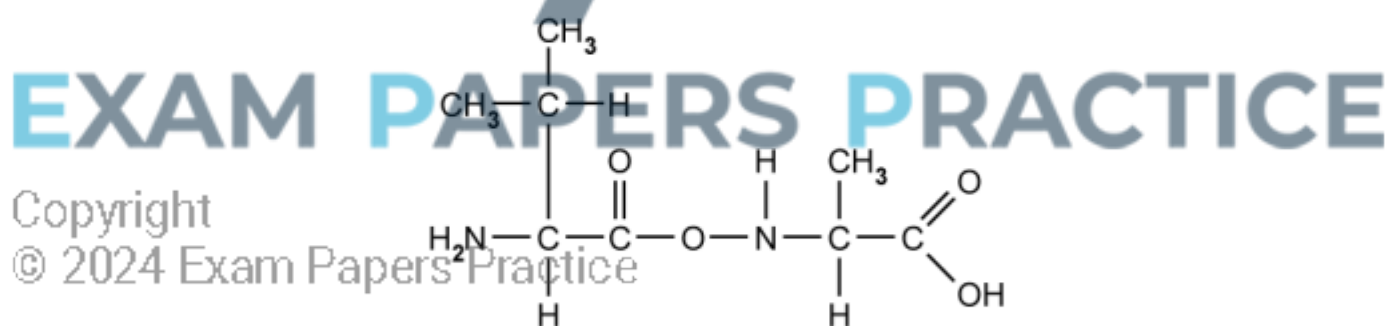
(1 mark)

### Question 3.

- (a) Valylalanine shown in Fig. 1.1, is an example of a dipeptide composed of two amino acids, valine and alanine.

When this compound is placed in acidic conditions, two species are formed.

Draw **one** of these two species.



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(1 mark)



- (b) A dipeptide made from the amino acids cysteine and tryptophan is shown in Fig.1.2 .  
Cysteine contains a sulphur molecule.

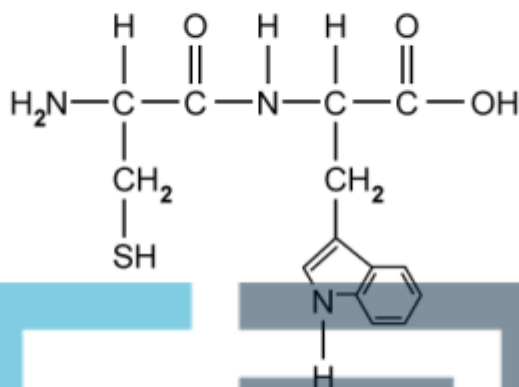


Fig. 1.2

Draw the structure of the amino acid tryptophan.

(1 mark)



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(1 mark)

- (c) Amino acids such as serine shown in Fig. 1.3 will form polyamide links. Polyamides will contain the same type of links and these polymers can be used to form fibres suitable for weaving. Polymers formed from alkenes by additional polymerisation are usually too weak for this purpose.

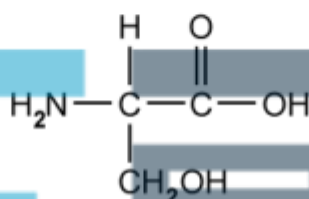


Fig. 1.3

In terms of intermolecular forces between the polymer chains, explain why polyalkenes are not suitable to be used as fibres for weaving.

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(3 marks)

- (d) Explain why the molecule  $\text{NH}_2\text{CH}_2\text{CH}_2\text{COCl}$  can form a condensation polymer with itself.

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(2 marks)



Question 4.

- (a) Polyurethanes are polymers made by the reaction of a diisocyanate with a diol as shown in Fig. 2.1.  $R^1$  and  $R^2$  are hydrocarbon groups.

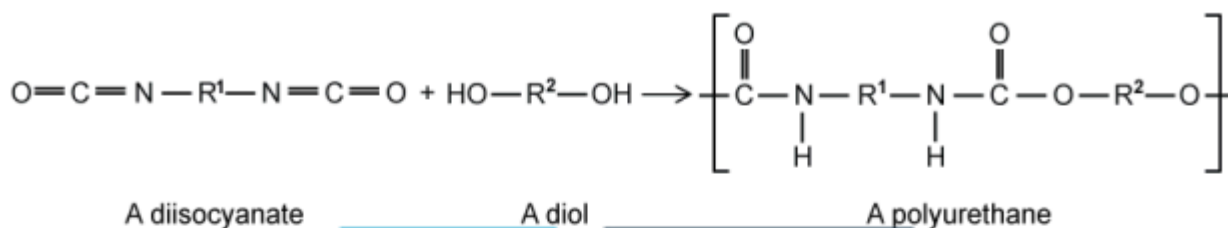


Fig. 2.1

Lycra® in Fig. 2.2 is a polyurethane formed from the diisocyanate **P** and  $\text{HOCH}_2\text{CH}_2\text{OH}$ .

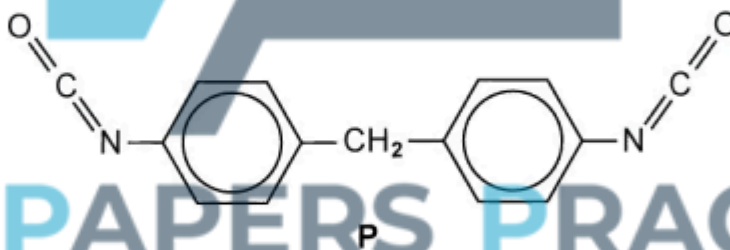


Fig. 2.2

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- i) Give the molecular formula for **P**.

[1]

- ii) Draw the repeat unit of Lycra®.

[2]

(3 marks)



- (b) Fibres of Lycra® are strong due to the intermolecular forces between the polymer chains. Complete the table to identify two intermolecular forces responsible for this property and the group(s) involved.

Intermolecular force	Group(s) involved

(2 marks)

- (c) Name one example of each of the following types of polymer.

Type of polymer	Example
Synthetic polyamide	
Synthetic polyester	

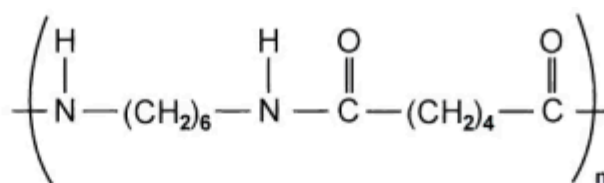
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(2 marks)

- (d) Fig. 2.3 shows the repeat unit of Nylon 66.





NaOH / H<sub>2</sub>O

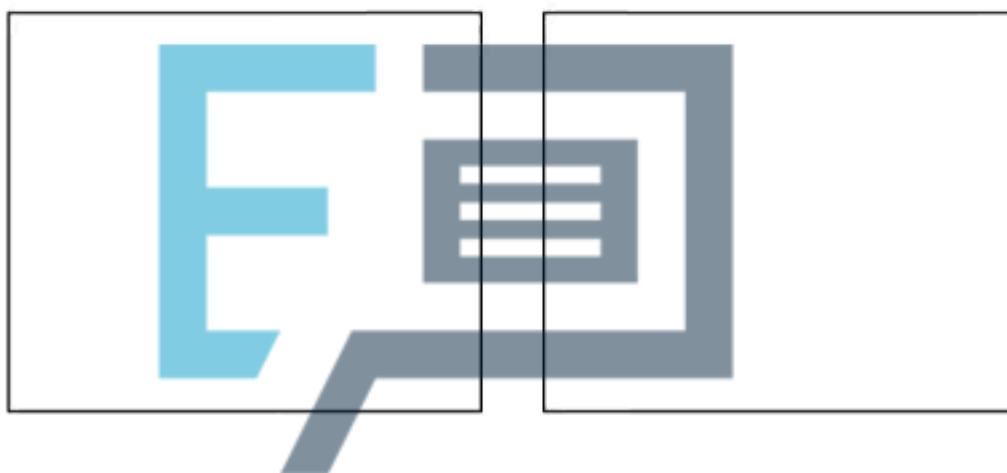


Fig. 2.3

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Draw the **two** products from the hydrolysis of Nylon 66.

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(2 marks)



**Question 5.**

- (a) Ethane-1,2-diamine is a bidentate ligand as well as being a useful reagent in organic chemistry.

Explain how ethane-1,2-diamine acts as a Brønsted-Lowry base.

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(1 mark)

- (b) Write an equation to show the reaction of ethane-1,2-diamine with an excess of hydrochloric acid.

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(1 mark)

- (c) Ethane-1,2-diamine can react with ethanedioic acid, HOOC<sub>2</sub>COOH, to form a condensation polymer.

Draw the skeletal formula of the polymer, showing two repeat units.

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(2 marks)



**Question 6.**

- (a) Polymers consist of monomers joined together by undergoing either addition or condensation polymerisation.

Fig. 1.1 shows a dicarboxylic acid and a diol that can be used in a general condensation polymerisation reaction.

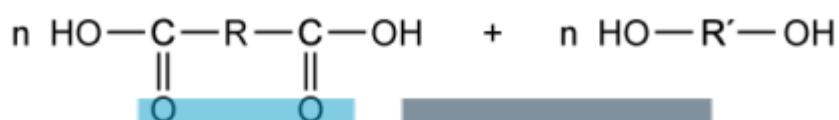


Fig. 1.1

Draw **one** repeat unit for this polymerisation.



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(1 mark)

- (b) In terms of  $n$ , state the number of molecules of water formed in the condensation polymerisation reaction of a general dicarboxylic acid and a general diol as shown in Fig. 1.1.

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(1 mark)



- (c) Using displayed formulae, write the balanced equation for the condensation polymerisation of the two monomers, propanedioyl dichloride and butane-1,4-diol.

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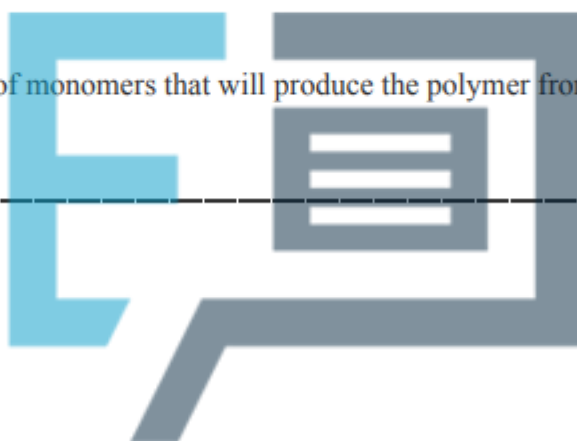
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(3 marks)

- (d) Suggest an alternative pair of monomers that will produce the polymer from part (c).

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(1 mark)



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**Question 7.**

(a) Lactic acid has the structural formula,  $\text{CH}_3\text{CHOHCOOH}$ .

i) Name all the functional groups in lactic acid.

[1]

ii) Give the systematic name of lactic acid.

[1]

iii) Lactic acid exhibits stereoisomers.

Draw three-dimensional structures for the two stereoisomers of lactic acid.  
Name this type of stereoisomerism.

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type of stereoisomerism .....

[2]

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**(4 marks)**



- (b) Poly(lactic acid) is a thermoplastic polyester that can be prepared from lactic acid. It is a renewable material used widely in 3D printers.

Explain why lactic acid can be polymerised.

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(1 mark)

- (c) Polylactic acid contains methyl groups.

i) Draw the **skeletal** formula for **three** repeat units of poly(lactic acid).

[1]

ii) Explain what happens to the chirality of lactic acid when it is polymerised.

[1]

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(2 marks)

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- (d) Poly(lactic) acid can be prepared using a different monomer.

Draw the **skeletal** formula of this monomer.

Give the systematic name of another monomer that could make poly(lactic acid).



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systematic name .....



(2 marks)

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**Question 8.**

One family of condensation polymers are the aramids, so called because of the arene rings that are linked together with amide bonds. Kevlar<sup>®</sup> and Nomex<sup>®</sup> are two common examples of aramids.

- (a) Kevlar<sup>®</sup> has a variety of uses, including bulletproof vests and puncture resistant tyres, due to its strength and being lightweight. Nomex<sup>®</sup> is most commonly used as a lining of the overalls worn by racing drivers and their pit crews as well as in the personal protective equipment of firefighters due to its flame resistant properties.

Nomex<sup>®</sup> is made from 1,3-diaminobenzene and 1,3-benzenedicarboxylic acid.

Draw the **skeletal** structures of these monomers.

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(2 marks)

- (b) Draw the structure of the Nomex<sup>®</sup> polymer.

(3 marks)





(c) Kevlar<sup>®</sup> is made from 1,4-diaminobenzene and 1,4-benzenedicarboxylic acid.

Draw **two** repeat units of the polymer to show the strongest intermolecular force in Kevlar<sup>®</sup>.

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(2 marks)

(d) State whether Kevlar<sup>®</sup> or Nomex<sup>®</sup> will have the higher melting point.

Explain your answer.

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(2 marks)

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