Polymerisation

Question Paper 6

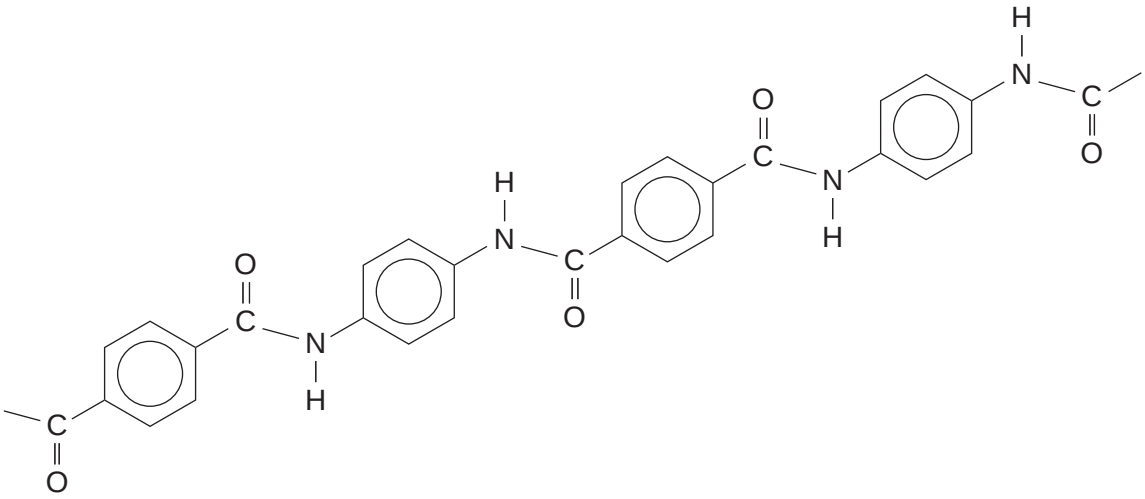
Level	International A Level
Subject	Chemistry
Exam Board	CIE
Topic	Polymerisation
Sub-Topic	
Paper Type	Theory
Booklet	Question Paper 6

Time Allowed:	**74 minutes**
Score:	**/61**
Percentage:	**/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	777.5%	70%	62.5%	57.5%	45%	<45%

1 **(a)** Spider silk is a natural polymer which has an exceptional strength for its weight. *Kevlar* is a man-made polymer designed to have similar properties. It has a wide variety of uses from sporting equipment to bullet-proof vests.



Kevlar

(i) In *Kevlar*, the polymer strands line up to form strong sheets with bonds between the strands.

On the diagram above, draw part of a second polymer chain showing how bonds could be formed between the chains.

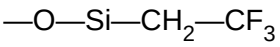
(ii) Suggest what type of bonds these are.

.....

(iii) Draw **two** possible monomer molecules for making the polymer *Kevlar*.

[5]

(b) The transport of oil by sea has resulted in a number of oil spills in recent years. As well as a waste of a valuable resource, these have caused major environmental problems. Traditional sorbent materials absorb water and sink. Researchers have developed new sorbent materials to help collect the spilled oil. The sorbent consists of a material called 'hydrophobic aerogels'. This is a network of silicon(IV) oxide with some of the silicon atoms attached to fluorine-containing groups.



The introduction of these fluorine-containing groups allows the oil to be absorbed but not the water. Tests show that these materials can absorb more than 200 times their mass of oil without sinking.

(i) Suggest what the word **hydrophobic** means.

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(ii) Suggest why the fluorine-containing groups allow oil to pass through but not water molecules.

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.....

.....

(iii) Suggest another important fluorine-containing polymer that repels water-containing materials.

.....

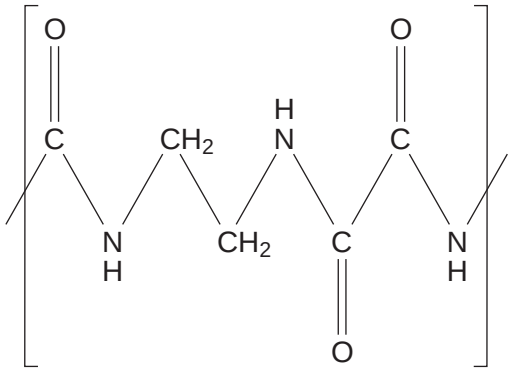
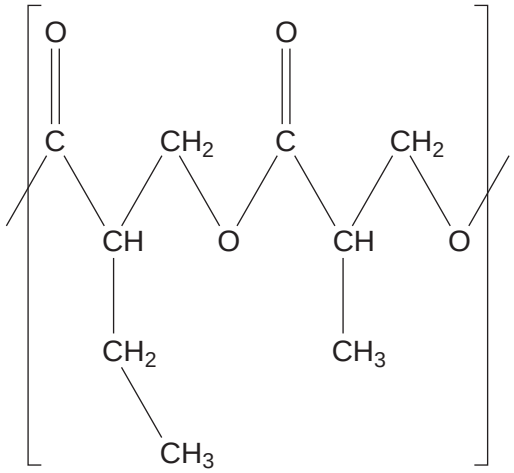
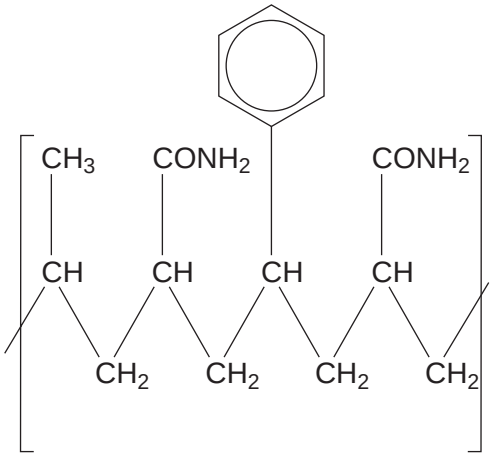
[4]

[Total: 9]

2 Each of the following structures is an 8-atom segment of the chain of a commercial polymer.

For each structure,

- decide whether it is part of a condensation or an addition polymer, and
- draw the structural formulae of the monomer(s) from which the polymer is made.

polymer	addition or condensation?	formulae of monomers
		
		
		

[8]

[Total: 8]

3 **(a)** State and show, using suitable diagrams, the types of bonding that occur in the primary, secondary and tertiary structures of a protein.

primary

secondary

tertiary

[6]

(b) Analysis of a polypeptide **A** showed that the amino-(N-)terminal end is methionine (met) and that the carboxyl-(C-)terminal end is lysine (lys).

Enzymic hydrolysis of the polypeptide produced the following tripeptides, with the amino acid residue on the left having the free amino group.

met-ala-gly gly-arg-val ala-gly-arg arg-val-lys ala-gly-ala gly-ala-gly

Work out the sequence of amino acids in **A**, using the 3-letter abbreviations. Use each tripeptide once only.

[2]

(c) Give **two** examples of how interchanging the positions of two amino acids could affect the bonding in, and hence the overall structure of, the protein.

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.....

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.....

..... [4]

[Total: 12]

4 **(a)** A number of drugs, such as insulin for diabetics, are delivered by injection rather than by mouth (oral delivery). Suggest **two** reasons why this might be necessary.

(i) .....

.....

(ii) .....

.....

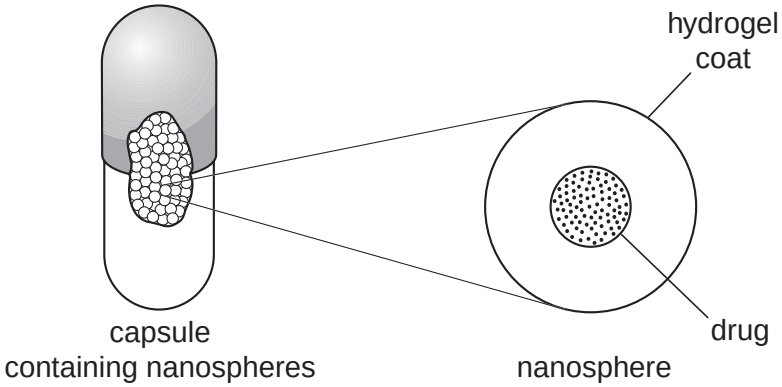
[2]

(b) Many patients prefer oral delivery to injection, and a number of methods for overcoming the problems of oral delivery are being investigated. Several of these use nanotechnology.

Study the passage and diagram and then answer the questions that follow.

At a 2004 meeting, engineers from the University of Texas described their research into nanospheres for oral drug delivery. Nanospheres can transport a drug safely through the hostile environment of the stomach.

The nanospheres are created from hydrogels which are stable, organic materials formed from a network of polymer chains. Hydrogels have a variety of uses including disposable nappies, soft contact lenses, dressings for burns and, more recently, drug delivery. The drug is contained in the hydrogel nanosphere as shown in the diagram below. Hydrogels absorb water and swell at a rate dependent on the pH of their environment. As the hydrogel swells, the drug is released.



(i) What is a *nanosphere*?

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(ii) Suggest why the stomach might be a particularly hostile environment for drugs.

.....

.....

(iii) Suggest **two** ways in which the nanosphere shown in the diagram can be modified to change the rate of drug release.

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.....

[4]

(c) Hydrogels may be formed as homopolymers (using a single monomer), or heteropolymers (using two or more different monomers).

By using the monomers below, you are to draw sections of **both** a homopolymer and a heteropolymer. Each of your drawings should show a three-monomer section of the polymer.

$HOCH_2CH_2OH$ $HO_2CCHRNH_2$ $HO_2CCH(OH)CH_2CO_2H$

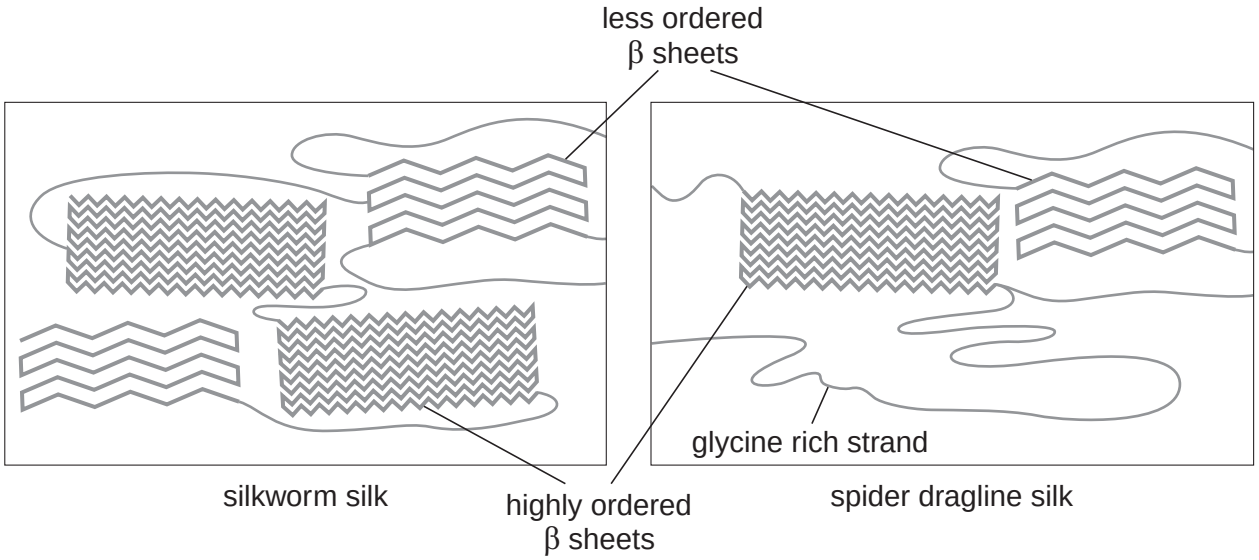
homopolymer

heteropolymer

[3]

[Total: 9]

5 **(a)** Silk from silkworms, used as a fabric shows a different secondary structure to that produced by spiders.



(i) What sort of bonding would you expect to occur between adjacent parts of the protein chains in each form of silk?

silkworm .....

spider .....

(ii) Suggest **two** differences in properties that these forms of silk could have. Explain your answer.

.....

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.....

(iii) Spider dragline silk contains large amounts of the amino acid glycine. How does this affect the properties of the silk?

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[5]

(b) Both forms of silk are condensation polymers.

(i) Explain what is meant by a condensation polymer.

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(ii) Another type of polymer is called an addition polymer. Name an example of an addition polymer.

.....

(iii) Suggest why condensation polymers such as proteins show a wider range of properties than addition polymers.

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[5]

[Total: 10]

6 **(a)** **(i)** In a protein, amino acids are joined together by a process called *condensation polymerisation*. *Addition polymerisation* is used in some synthetic polymers, such as poly(propene).

State **two** important differences between *condensation polymerisation* and *addition polymerisation*.

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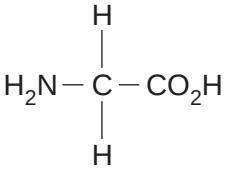
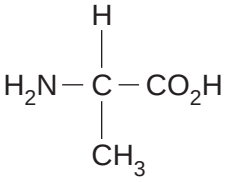
(ii) Using the amino acids glycine and alanine shown, draw the displayed formula of the dipeptide ala-gly, clearly labelling the peptide link.



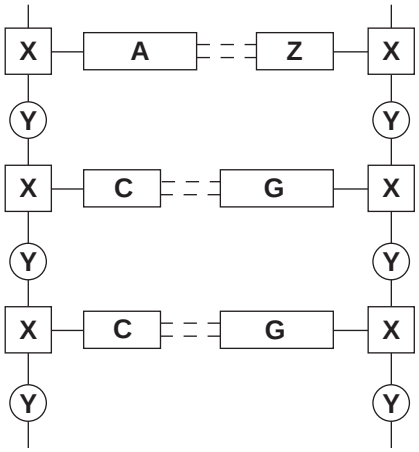
glycine



alanine

[4]

(b) The diagram below shows a section of DNA.
Identify the blocks labelled **X**, **Y** and **Z**.



X ..... **Y** ..... **Z** .....

[3]

(c) The table below shows the 3-base codes used by RNA.

UUU	phe	UCU	ser	UAU	tyr	UGU	cys
UUC	phe	UCC	ser	UAC	tyr	UGC	cys
UUA	leu	UCA	ser	UAA	stop	UGA	stop
UUG	leu	UCG	ser	UAG	stop	UGG	trp
CUU	leu	CCU	pro	CAU	his	CGU	arg
CUC	leu	CCC	pro	CAC	his	CGC	arg
CUA	leu	CCA	pro	CAA	gln	CGA	arg
CUG	leu	CCG	pro	CAG	gln	CGG	arg
AUU	ile	ACU	thr	AAU	asn	AGU	ser
AUC	ile	ACC	thr	AAC	asn	AGC	ser
AUA	ile	ACA	thr	AAA	lys	AGA	arg
AUG	met/ start	ACG	thr	AAG	lys	AGG	arg
GUU	val	GCU	ala	GAU	asp	GGU	gly
GUC	val	GCC	ala	GAC	asp	GGC	gly
GUA	val	GCA	ala	GAA	glu	GGA	gly
GUG	val	GCG	ala	GAG	glu	GGG	gly

(i) What amino acid sequence would the following base code produce?
(You may use abbreviations in your answer.)

-AUGUCUAGAGACGGGUAA-

.....

.....

(ii) What would be the effect on the amino acid sequence if a mutation caused the base G at position 13 in the sequence to be replaced by U?

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[3]

(d) **(i)** Name a disease which results from a genetic defect.

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(ii) Explain how the genetic defect can bring about your named disease.

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[3]

[Total: 13]