

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

CHEMISTRY

Biochemistry

2815/02

Tuesday

28 JUNE 2005

Morning

50 minutes

Candidates answer on the question paper.

Additional materials:

Data Sheet for Chemistry

Scientific calculator

Candidate Name	Centre Number	Candidate Number										
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TIME 50 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.

INFORMATION FOR CANDIDATES

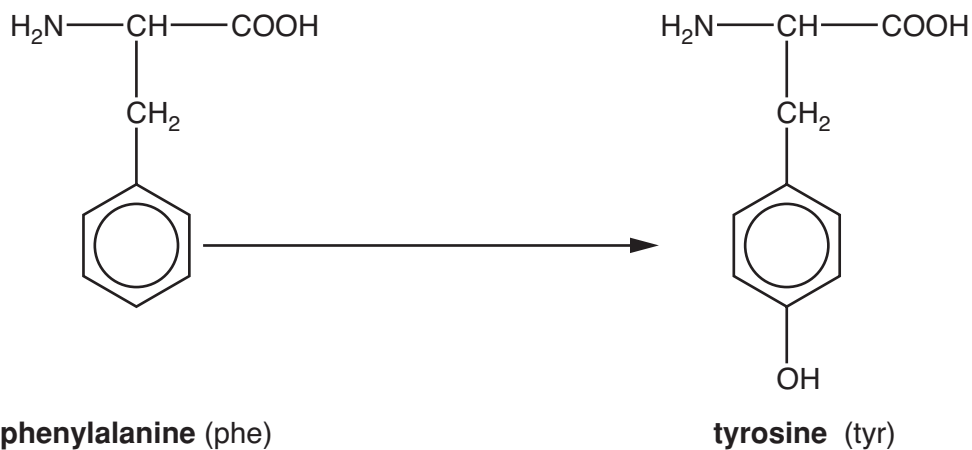
- The number of marks is given in brackets [] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- You may use the *Data Sheet for Chemistry*.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	14	
2	7	
3	11	
4	13	
TOTAL	45	

This question paper consists of 11 printed pages and 1 blank page.

Answer **all** the questions.

- 1 The enzyme phenylalanine hydroxylase catalyses the oxidation of the amino acid phenylalanine.



- (a) State **two** ways in which an enzyme such as phenylalanine hydroxylase differs from a simple inorganic catalyst such as nickel.

.....

 [2]

- (b) Draw the structure of the dipeptide formed between two molecules of tyrosine.

[2]

- (c) Explain how the side chains of phenylalanine and tyrosine could be involved in the maintenance of the tertiary structure of a protein.

phenylalanine:

.....

.....

.....

tyrosine:

.....

.....

.....[4]

- (d) The disease phenylketonuria is caused by a single change in the base sequence of the section of DNA which codes for the enzyme phenylalanine hydroxylase.

Explain how a change in one base in DNA could change one amino acid in an enzyme, making the enzyme ineffective.

Follow the base change in DNA, through the base change in m-RNA, to the new amino acid using the table below. (You are not expected to know the actual base sequence involved in phenylketonuria.)

first base in triplet in m-RNA	second base in triplet in m-RNA				third base in triplet in m-RNA
	U	C	A	G	
U	phe	ser	tyr	cys	U
	phe	ser	tyr	cys	C
	leu	ser	stop	stop	A
	leu	ser	stop	trp	G
C	leu	pro	his	arg	U
	leu	pro	his	arg	C
	leu	pro	gln	arg	A
	leu	pro	gln	arg	G
A	ile	thr	asn	ser	U
	ile	thr	asn	ser	C
	ile	thr	lys	arg	A
	met/start	thr	lys	arg	G
G	val	ala	asp	gly	U
	val	ala	asp	gly	C
	val	ala	glu	gly	A
	val	ala	glu	gly	G

- 2 This question is about the appetite-boosting peptide, orexin A. The primary structure of orexin A is shown below.

–leu–thr–leu–ile–gly–ala–ala–his–asn–gly–ala–gly–his–leu–leu–glu–
 tyr–leu–arg–cys¹–ser–cys²–thr–lys–gln–arg–cys³–cys⁴–asp–pro–leu–pro–tyr–

orexin A

- (a) There are two bridges: one between cys¹ and cys³, and the other between cys² and cys⁴.

The amino acid cysteine (cys) has the structure H₂NCH(CH₂SH)COOH.

- (i) Redraw the structure of orexin A to show the two bridges in place. You should represent the peptide chain with a line.

[2]

- (ii) Explain the difference between the cys-cys link in the primary structure and that forming the bridges.

.....

.....

.....

.....[3]

- (b) An enzyme involved in the synthesis of the t-RNA for cysteine has a zinc ion at the binding site for the amino acid.

Suggest how the cysteine binds to this zinc ion.

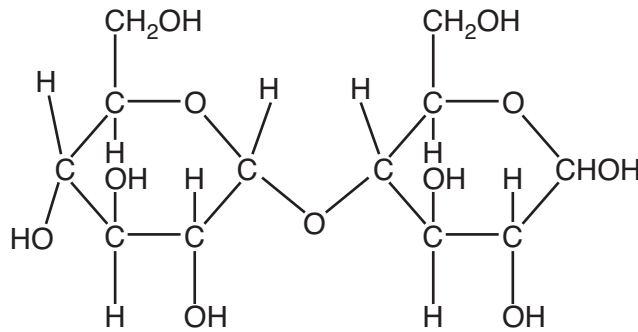
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.....[2]

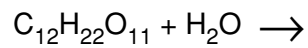
[Total: 7]

- 3 Maltose and cellobiose are both disaccharides. Maltose can be hydrolysed using the enzyme maltase.



maltose

- (a) (i) Complete the equation for the hydrolysis of maltose.



[1]

- (ii) Describe **two** similarities and **one** difference in the structures of maltose and cellobiose.

similarities:

.....

.....

difference:

.....[3]

- (b) Suggest why the hydrolysis of cellobiose is **not** catalysed by maltase.

.....

.....[1]

- 4 Carbohydrates, such as glucose, and fatty acids, such as octadecanoic acid, are both used as energy sources in cells. They are oxidised to carbon dioxide and water in many steps, each of which involves an enzyme.

glucose	octadecanoic acid
$M_r = 180$	$M_r = 284$
$\Delta H_c = -2800 \text{ kJ mol}^{-1}$	$\Delta H_c = -11\,360 \text{ kJ mol}^{-1}$

- (a) Calculate the mass of glucose required to produce the same amount of heat on complete combustion as 1.00 g of octadecanoic acid. Show your working.

[3]

- (b) Explain why fatty acids produce more energy per gram than carbohydrates.

.....

.....

.....

.....[3]

- (c) Glucose is stored in plants as starch, which is a mixture of amylose and amylopectin. Suggest **three** ways in which the structures of these polysaccharides are well suited to their function.

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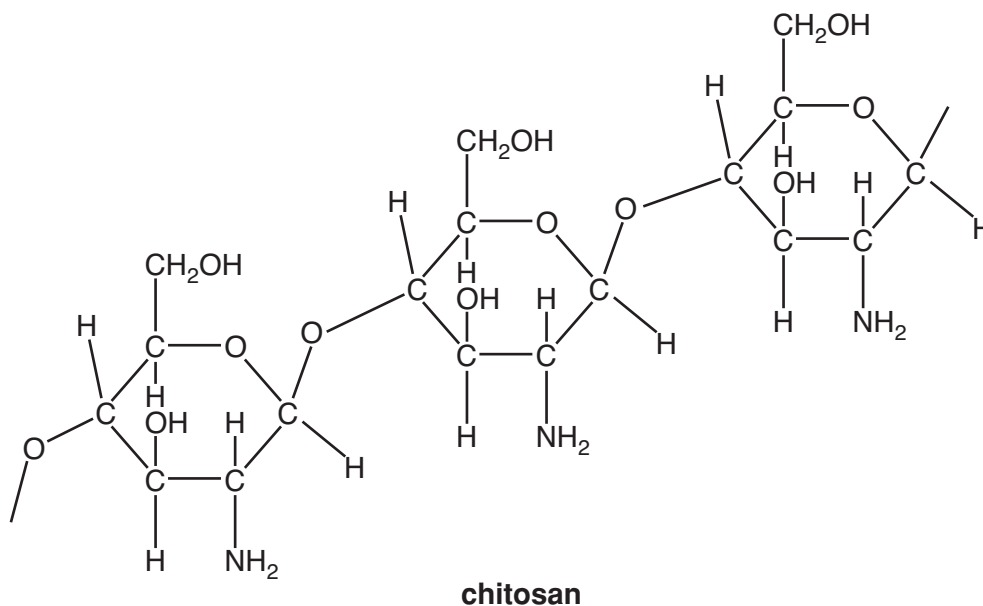
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.....[3]

- (d) Chitosan is a polymer from shrimp shells which can be used to stop bleeding.



- (i) Suggest the structural formula of the monomer of chitosan.

[1]

- (ii) Chitosan may be broken down into the monomer by an enzyme. Describe another way in which chitosan may be broken down.

.....
[2]

- (iii) Explain how chitosan is structurally related to cellulose.

.....
[1]

[Total: 13]

END OF QUESTION PAPER

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