

**ADVANCED GCE
CHEMISTRY**

Biochemistry

THURSDAY 19 JUNE 2008

2815/02

Morning
Time: 50 minutes

Candidates answer on the question paper

Additional materials (enclosed): *Data Sheet for Chemistry*

Additional materials (required):
Scientific calculator



Candidate
Forename

Candidate
Surname

Centre
Number

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Candidate
Number

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INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **45**.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- A copy of the *Data Sheet for Chemistry* is provided as an insert with this question paper.
- You are advised to show all the steps in any calculation.

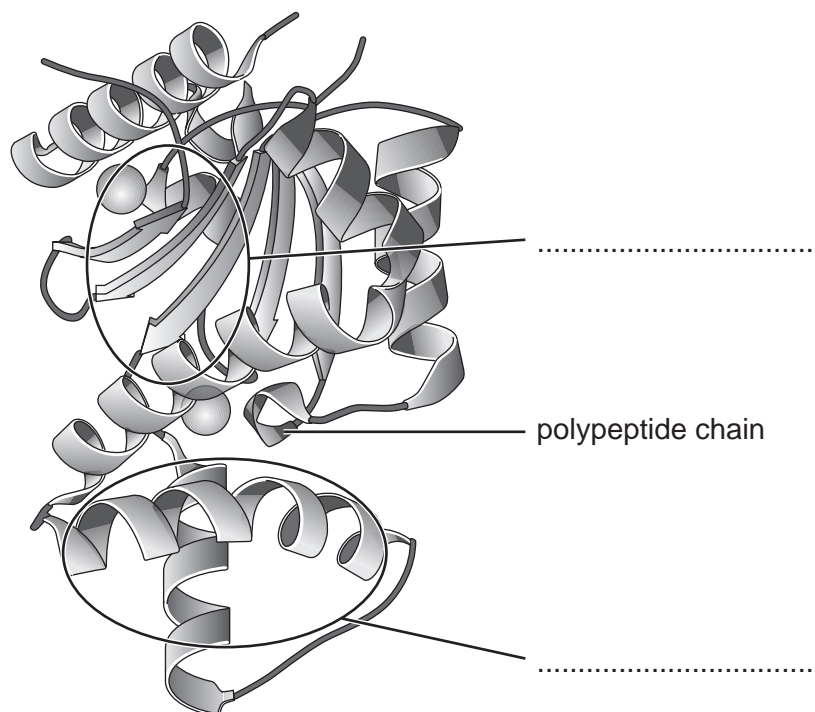
FOR EXAMINER'S USE

Qu.	Max.	Mark
1	8	
2	11	
3	7	
4	9	
5	10	
TOTAL	45	

This document consists of **12** printed pages and a *Data Sheet for Chemistry*.

Answer **all** the questions.

- 1 The diagram represents the structure of the bacterial enzyme cellulase, showing its secondary and tertiary structure.



- (a) (i) On the diagram above, complete the labels for each type of secondary structure. [2]
- (ii) Explain what holds each type of *secondary* structure together. Your answer should include a diagram, with any atoms or groups involved clearly shown.

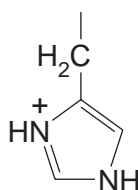
.....

.....

.....

.....[2]

- (b) Histidine is one of the amino acids in cellulase. Its side chain is shown below.



histidine side chain

Suggest **two** ways in which this side chain might help to stabilise the tertiary structure of cellulase.

.....

.....

.....

.....

.....[2]

- (c) The tertiary structure of cellulase can be changed by heat, or by the addition of heavy metal ions.

Why is the tertiary structure changed by:

- (i) heat?

.....

.....

.....[1]

- (ii) heavy metal ions?

.....

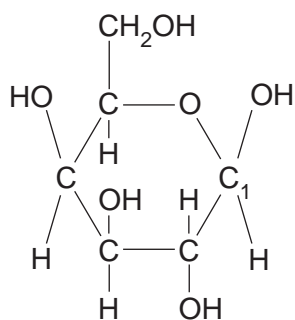
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.....[1]

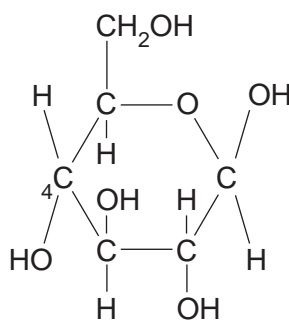
[Total: 8]

2 Lactose is a disaccharide found in milk.

In lactose, a molecule of D-galactose is joined to a molecule of D-glucose by a 1β -4 link.



D-galactose



D-glucose

(a) Suggest an open chain structure for D-galactose.

[2]

- (b) Draw the structure of lactose, showing how D-galactose is joined to D-glucose.

[2]

- (c) Lactose can be hydrolysed using the enzyme lactase. Immobilised lactase is used to make lactose-free milk for people who are lactose-intolerant.

The lactose-free milk can easily be separated from the immobilised enzyme.

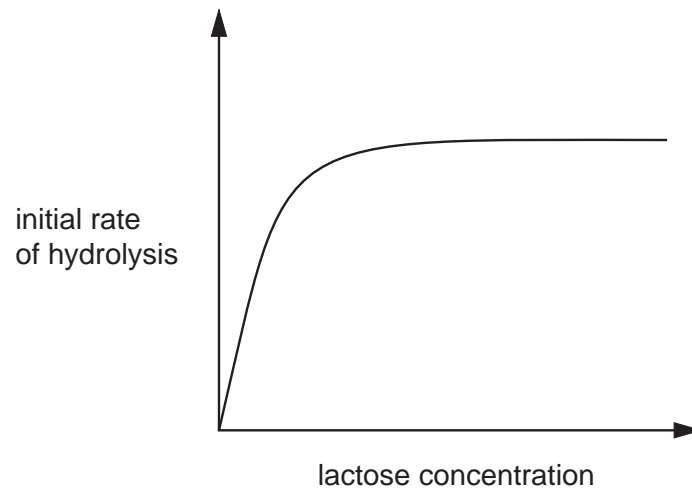
- (i) Suggest how lactose-free milk can be separated from immobilised lactase.

.....
.....
.....[1]

- (ii) State **two other** advantages of immobilising the enzyme.

.....
.....
.....
.....[2]

- (d) The diagram below shows how the initial rate of the lactase catalysed hydrolysis varies with lactose concentration.



- (i) At low lactose concentrations the initial rate of hydrolysis increases with lactose concentration.

Explain why.

.....
[2]

- (ii) D-Galactose is a competitive inhibitor of the enzyme lactase.

What is meant by the term *competitive inhibitor*?

.....
[1]

- (iii) On the diagram above, draw a curve to show how the initial rate of hydrolysis would vary with lactose concentration in the presence of D-galactose. [1]

[Total: 11]

- 3** In this question, one mark is available for the quality of use and organisation of scientific terms.

Cellulose has a structural role in plants, but amylose is used only for storage.

Compare the structures of cellulose and amylose. Suggest how these structures make cellulose and amylose suitable for their functions.

.....[6

Quality of Written Communication [1]

[Total: 7]

[Turn over

- 4 The phosphoglyceride, phosphatidyl serine, is a common component of bimolecular layers in cell membranes.

(a) Phosphatidyl serine is made out of the following:

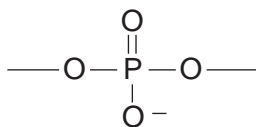
serine, $\text{HOCH}_2\text{CH}(\text{NH}_3^+)\text{COO}^-$

glycerol (propane-1,2,3-triol)

phosphate

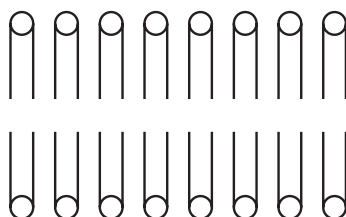
stearic acid, $\text{C}_{17}\text{H}_{35}\text{COOH}$ (two units)

Complete the structure of phosphatidyl serine, using the phosphate group shown below. Serine is linked through its CH_2OH group.



[3]

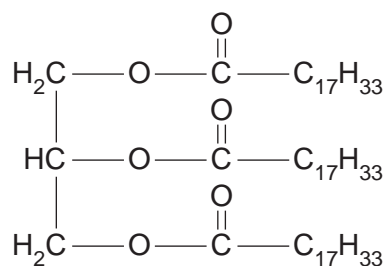
- (b) Phospholipids form bimolecular layers, which are an essential feature of the membranes which surround cells.



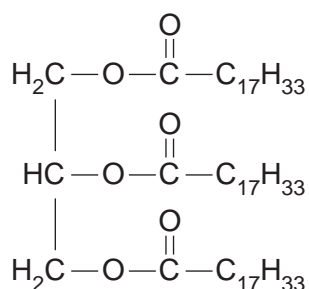
What holds the bimolecular layer together?

.....[1]

(c) The diagram below shows the structure of the triglyceride triolein found in olive oil.



- (i) Triolein can be hydrolysed using hot aqueous sodium hydroxide. Complete a balanced equation for this reaction.



[2]

- (ii) State **one** commercial application of this reaction.

.....[1]

- (d) Triglycerides and carbohydrates may both be oxidised in cells to provide energy. On complete oxidation, triglycerides release much more energy per gram than carbohydrates.

Why do triglycerides release more energy per gram on oxidation than carbohydrates?

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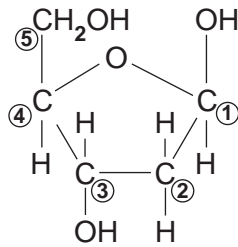
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.....[2]

[Total: 9]

5 This question is about DNA.

(a) The sugar in DNA is deoxyribose.



In the DNA structure, identify which of the carbon atoms ①–⑤ are attached to:

(i) phosphates,

.....[1]

(ii) a base.

.....[1]

(b) (i) DNA is a condensation polymer.

What is meant by the terms *condensation* and *polymer* in this context?

.....

[2]

(ii) Describe, with a diagram, **one** type of interaction that holds the two strands of DNA together in a double helix.

.....

[2]

- (c) Describe the process of **replication** of DNA. Include the role of intermolecular forces in your answer.

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.....[4]

[Total: 10]

END OF QUESTION PAPER

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