

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

CHEMISTRY

2815/02

Biochemistry

Wednesday

25 JANUARY 2006

Afternoon

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	11	
2	11	
3	10	
4	13	
TOTAL	45	

This question paper consists of 10 printed pages and 2 blank pages.

Answer **all** the questions.

- 1 Glyceryl trihexanoate is a triglyceride that can be made from glycerol (propane-1,2,3-triol) and hexanoic acid, $C_5H_{11}COOH$.

(a) Draw the structure of glyceryl trihexanoate. Show every bond in the functional groups.

[2]

- (b) The enzyme lipase catalyses the hydrolysis of triglycerides.
This reaction is used to monitor the storage of prepackaged foods, which can go bad if kept above $5^\circ C$.
A suspension of glyceryl trihexanoate, lipase and a pH indicator changes colour when the temperature has been above $5^\circ C$ for too long.

(i) Explain why the indicator changes colour during this hydrolysis.

..... [1]

(ii) Explain why the indicator does **not** change colour if the mixture remains below $5^\circ C$.

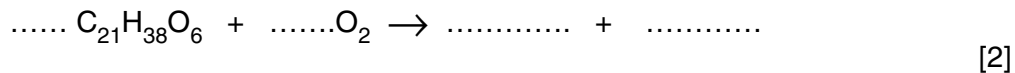
.....
..... [1]

(iii) Above $70^\circ C$, the lipase is denatured. Explain what this means.

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

(c) Glyceryl trihexanoate contains 75% by mass of carbon and hydrogen together. Glucose contains 47% by mass of carbon and hydrogen together.

(i) Complete this equation for the complete oxidation of glyceryl trihexanoate.



(ii) On complete oxidation, glyceryl trihexanoate releases more energy per gram than glucose. Explain why, with reference to the bond making and breaking involved in these oxidations.

.....
.....
.....
.....
.....
..... [3]

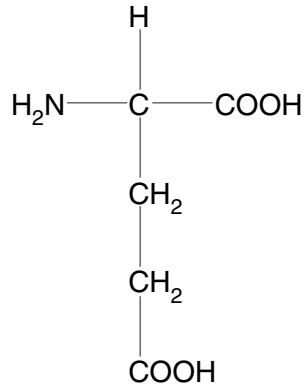
[Total: 11]

- 3 Abnormal haemoglobin is a feature of sickle cell anaemia. In the abnormal haemoglobin, one glutamic acid residue is replaced by valine.

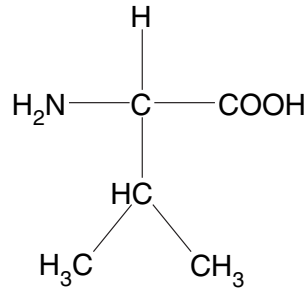
Normal haemoglobin -val-his-leu-thr-pro-**glu**-glu-lys-

Abnormal haemoglobin -val-his-leu-thr-pro-**val**-glu-lys-

Glutamic acid and valine may be represented by the structures shown below.



glutamic acid (glu)



valine (val)

- (a) (i) Draw the structure of the dipeptide glu-val.

[2]

- (ii) What term describes the sequence of amino acids in a protein?

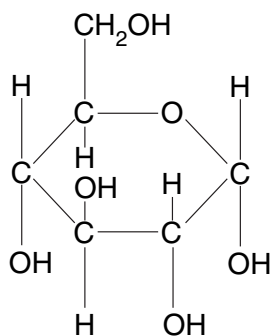
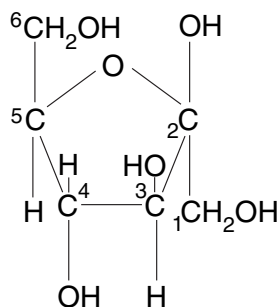
..... [1]

- (iii) Explain what is meant by the *quaternary* structure of haemoglobin.

.....

..... [2]

- 4 Sucrose, $C_{12}H_{22}O_{11}$, is a disaccharide formed by a $1\alpha-2\beta$ link between molecules of D-glucose and D-fructose. The structures of these compounds are shown below.

 α -D-glucose

D-fructose

- (a) Draw a structure for sucrose.

[2]

- (b) The open chain structure for fructose has two types of functional group.

- (i) Suggest an open-chain structure for *fructose*.

[1]

- (ii) Name the functional groups.

..... [1]

(c) The hydrolysis of sucrose is catalysed by the enzyme sucrase.

(i) Write an equation for this reaction.

..... [1]

(ii) The pentose D-xylose acts as a non-competitive inhibitor for the hydrolysis. Describe and explain the effect of D-xylose on the rate of reaction at different sucrose concentrations.

.....
.....
.....
..... [3]

(iii) Suggest the reagent and conditions for the hydrolysis of sucrose in the absence of enzyme.

..... [1]

(d) D-Glucose may be converted into the sweeter D-fructose using the enzyme glucose isomerase. On an industrial scale, this reaction is carried out using immobilised enzyme.

(i) State **two** advantages of immobilising an enzyme.

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

(ii) Explain, with a diagram, why glucose and fructose are soluble in water.

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

[Total: 13]

END OF QUESTION PAPER

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