OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE **2842**

SCIENCE

Science and Human Activity

THURSDAY 22 MAY 2008 Afternoon

Time: 1 hour

Candidates answer on the question paper
Additional materials (enclosed): None

Additional materials (required):
Electronic calculator

CUP/T47697

Candidate Forename		Candidate Surname	
Centre Number		Candidate Number	

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 **60**.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You are advised to show all the steps in any calculations.
- You may use an electronic calculator.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	**11**	
2	**15**	
3	**10**	
4	**14**	
5	**10**	
TOTAL	**60**	

This document consists of **13** printed pages and **3** blank pages.

[Turn over

Answer **all** the questions.

1 Proteins have a variety of roles in the human body. For example many proteins act as enzymes in cell processes. Others are present in specific structures in cells such as plasma membranes.

Ribbon diagrams of these two types of protein are shown in Fig. 1.1a and Fig. 1.1b.

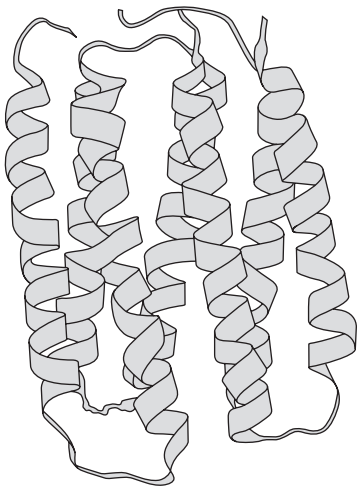


Fig. 1.1a
Membrane protein

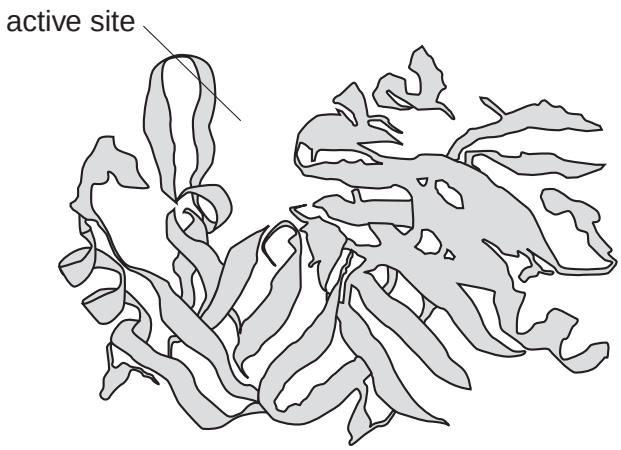


Fig. 1.1b
Enzyme

(a) Proteins are natural polymers. Name the type of monomer subunit from which they are built up.

..... [1]

(b) **(i)** The same structural feature is visible in both Fig. 1.1a and 1.1b. Name the structural feature present.

..... [1]

(ii) Fig. 1.1b shows the presence of an active site. Explain the importance of active sites in the action of enzymes.

.....

.....

.....

..... [3]

(c) Proteins present in membranes are often bonded to carbohydrates, such as the monosaccharide, glucose.

(i) Tick the **two** correct boxes next to the statements which best describe monosaccharides.

Smaller than a protein molecule	☐
Similar size to a protein molecule	☐
Larger than a protein molecule	☐
Have the general formula C_nH_m	☐
Have the general formula $C_n(H_2O)_n$	☐
Have the general formula C_nH_{2n+2}	☐

[2]

(ii) Describe **one** role of glucose in living organisms apart from in cell membranes.

.....

..... [2]

(d) Plant cells have a cell wall outside the cell membrane. This consists of polysaccharide molecules such as cellulose.

(i) State the meaning of the term polysaccharide.

.....

..... [1]

(ii) Give the name of another polysaccharide molecule, other than cellulose, found in living organisms.

..... [1]

[Total: 11]

2 In recent years car manufacturers have developed ways of reducing the environmentally damaging emissions from engines, such as oxides of nitrogen (NO_x).

One strategy has been to develop "lean burn" engines. These mix the petrol with more air than usual. One effect of this is to reduce the operating temperature of the engine.

(a) **(i)** Explain how oxides of nitrogen are formed in a car engine.

.....

.....

.....

..... [3]

(ii) Suggest a reason why oxides of nitrogen are less likely to form in a "lean burn" engine. Explain your answer.

.....

.....

..... [2]

(b) The emission of nitrogen monoxide (NO) eventually leads to the formation of nitric acid (HNO_3). Describe the processes involved in this conversion.

.....

..... [2]

(c) A second method of reducing pollution is to use a catalytic converter.

This causes the emissions to be converted into less harmful substances. However catalytic converters cannot be used with lean burn engines.

One reaction which occurs in the catalytic converter is:

$$2CO + 2NO \rightarrow N_2 + 2CO_2$$

(i) The NO is said to be **reduced** in this reaction. Explain how you can tell this from the equation.

.....

..... [1]

(ii) The reaction between the gases and the solid catalyst must happen as rapidly as possible.

State two things which could be done to increase the rate of reaction of the gases coming from the engine.

1. .....

2. ..... [2]

(d) The rates of reactions such as this one have been studied by chemists. Data from some experiments are summarised in the table below:

Concentration of NO / 10^{12} molecules cm^{-3}	**Rate / 10^{20} molecules cm^{-3} s^{-1}**
8.0	28.8
4.0	14.4
2.0	7.2

(i) The order of this reaction is 1. Explain how you can tell this from the data.

.....

..... [2]

(ii) Write a rate equation for the reaction which shows how the rate depends on the concentration of NO.

..... [2]

(iii) As a result of experiments such as the one above, chemists have deduced the mechanism for the reaction. One way in which it could be written is

1. $NO \rightarrow N + O$ (slow)

2. $O + CO \rightarrow CO_2$ (fast)

3. $N + N \rightarrow N_2$ (fast).

Write down the number of the step which is likely to be the rate-determining step in the mechanism. Justify your answer.

..... [1]

[Total: 15]

3 New techniques are being developed to purify sea water into drinkable water. One technique makes use of an electric field to remove the ions which make sea water impure.

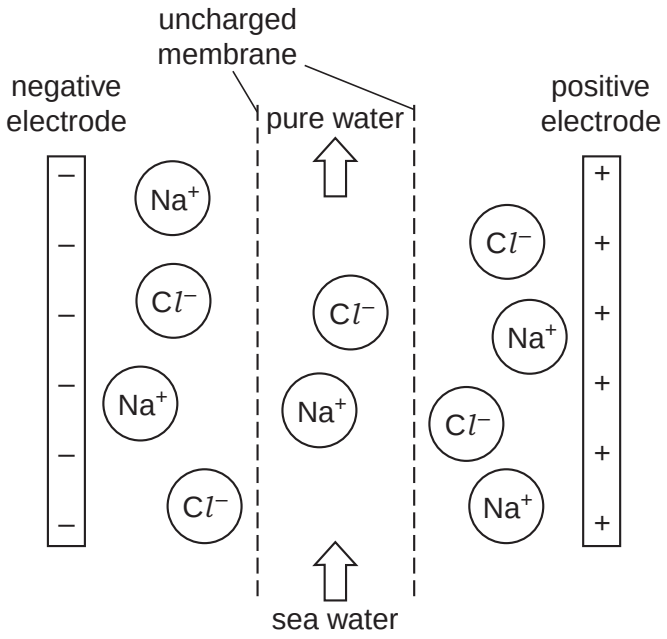


Fig. 3.1

(a) Fig. 3.1 shows the charges on each electrode. These charges produce an electric field.

(i) Sketch on Fig. 3.1 the field lines which would occur between the two plates (you are advised to show only a small number of lines). [2]

(ii) The strength of the field can be increased by making the charge greater on the two plates. What effect would this have on the pattern of field lines?

.....

..... [1]

(b) The sea water contains a variety of ions. The diagram above shows sodium ions, Na^+ and chloride ions, Cl^-, dissolved in water.

Describe the way that Na^+ and Cl^- ions will move when exposed to the electric field.

.....

..... [2]

(c) Purifying sea water requires an energy input.

(i) The equation which links the energy, E, transferred when a charge, Q, moves through a potential difference, V is shown below:

$$E = V \times Q$$

Use this to calculate the maximum charge which could be moved across a voltage of 5 V when 2000 J of energy is supplied.

charge = ... C [2]

(ii) Current is the rate of flow of charge.

Calculate the current which flows when a charge of 72 C passes in 6 minutes.

current = ... A [3]

[Total: 10]

4 In recent years there has been concern over the presence of molecules called *trans* fatty acids in many types of foods, including potato crisps and "ready meals".

(a) Fatty acids are found in a class of molecules known as lipids. One way of representing the structure of a lipid is shown in Fig. 4.1.

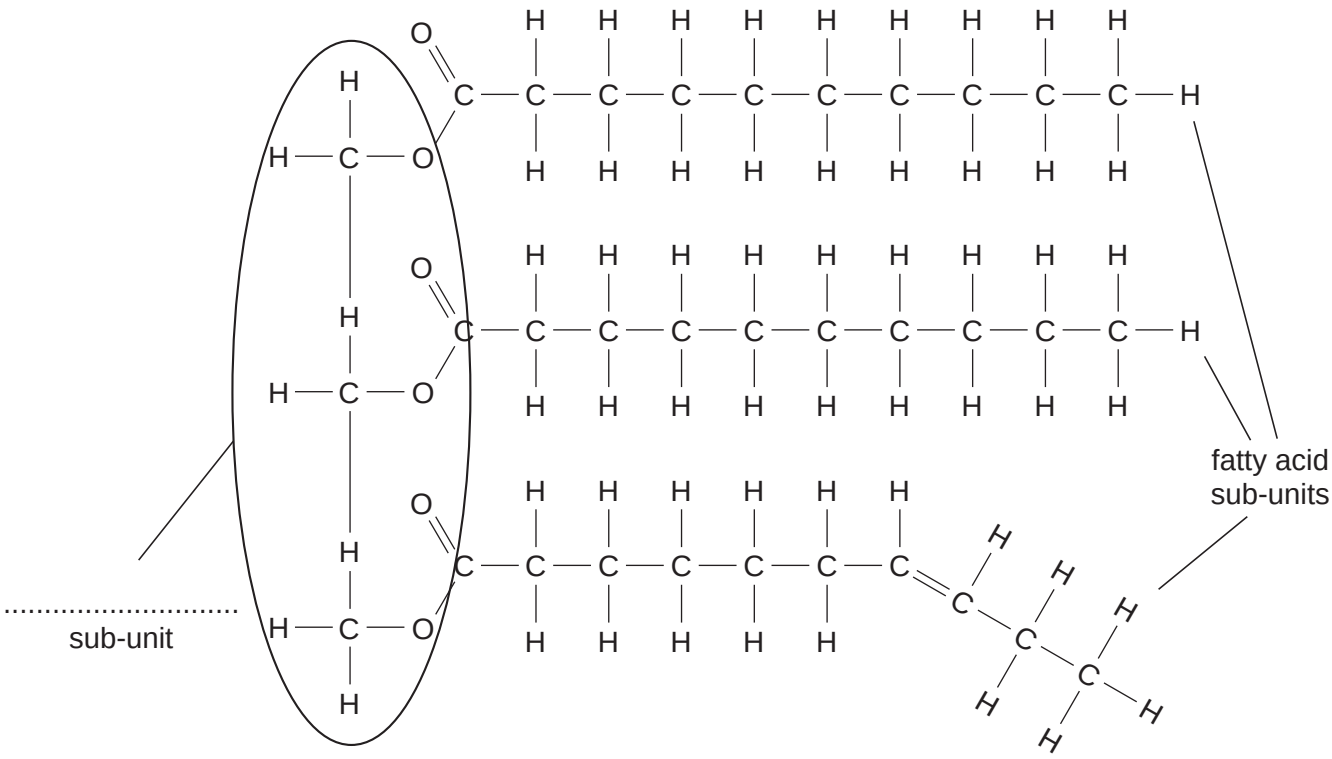


Fig. 4.1

(i) One of the types of sub-unit of the lipid molecule is labelled in the diagram. Complete the diagram by labelling the other sub-unit with an appropriate name. [1]

(ii) State how you can tell from the diagram that this lipid is unsaturated.

..... [1]

(b) Lipids are an important part of our diet. However there are health risks associated with high intakes of lipids.

(i) Describe **one** role of lipids in living organisms.

.....

..... [2]

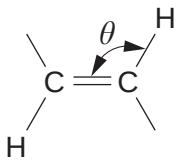
(ii) Apart from the risk of becoming overweight, suggest one other health risk associated with high intakes of lipids.

..... [1]

(c) Until recently unsaturated fats, such as the one shown in Fig. 4.1, were thought to be less harmful than saturated fats.

However some unsaturated fats added to food by manufacturers contain molecules described as *trans* fatty acids. The shape of these molecules is different to natural fatty acids. This may cause them to be harmful.

(i) Part of the structure of a trans fatty acid is shown below.



Use the electron pair repulsion theory to explain why the bond angle marked θ on the diagram has a value of approximately 120°.

.....

.....

.....

..... [3]

(ii) Trans fatty acids are manufactured by a process called hydrogenation.

A possible equation for a hydrogenation process is

$$C_6H_8O_2 + 2H_2 \rightarrow \text{……}$$

Complete the equation by writing in the molecular formula of the product which is formed. [1]

(d) Hydrogenation requires the use of a catalyst. This is usually a metal, for example nickel, palladium or cobalt.

(i) Explain how the use of a catalyst can result in a reduced environmental burden for a chemical process.

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..... [3]

(ii) Explain how the use of a metal catalyst, such as nickel, may also contribute to an increase in the environmental burden of a process.

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..... [2]

[Total: 14]

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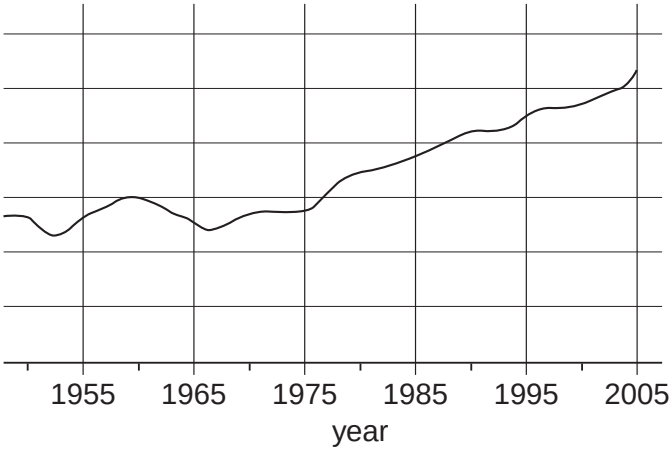
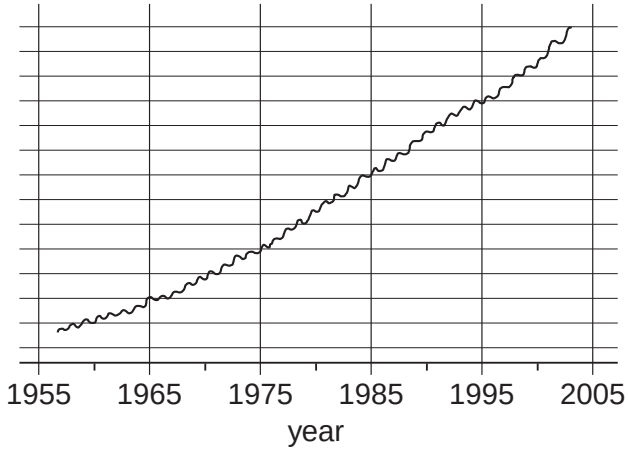
5 Most scientists are now convinced that the emission of “greenhouse gases”, such as carbon dioxide cause a warming of the atmosphere. Graphs which show how temperature and carbon dioxide concentration have varied over the past fifty years are shown in Fig. 5.1.



global temperature over the past fifty years



carbon dioxide concentration over the past fifty years

Fig. 5.1

(a) (i) State how these graphs could be used to support the argument that increasing carbon dioxide concentration causes an increase in global temperature.

.....

..... [1]

(ii) Suggest one reason why these graphs do not **prove** that increasing carbon dioxide concentration causes an increase in global temperature.

..... [1]

(b) In this question, two marks are available for the quality of your written communication.

Climate scientists are predicting that if the emission of greenhouse gases continues, the temperature of the Earth may rise by between 5 and 10 °C by the end of the century. This may produce catastrophic economic, social and environmental effects.

Discuss this information, by addressing the following points in your answer:

- Which processes produce greenhouse gases?
- Why are emissions expected to rise?
- Describe, in detail, two of the economic, social or environmental effects which a large temperature rise could produce.

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Quality of Written Communication [2]

[Total: 10]

END OF QUESTION PAPER

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