OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

BIOLOGY 2804

Central Concepts

Thursday **22 JANUARY 2004** Morning 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator
Ruler (cm/mm)

Candidate Name	Centre Number	Candidate Number

TIME 1 hour 30 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 blue or black ink, in the spaces provided on the question paper.
- Read each question carefully 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 an electronic calculator.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	16	
2	14	
3	14	
4	14	
5	13	
6	11	
7	8	
TOTAL	90	

This question paper consists of 17 printed pages and 3 blank pages.

Registered Charity Number: 1066969
[Turn over

Answer **all** the questions.

1 Fig. 1.1 shows a simple respirometer, **A**, that can be used to measure the rate of respiration of small invertebrates, such as maggots.

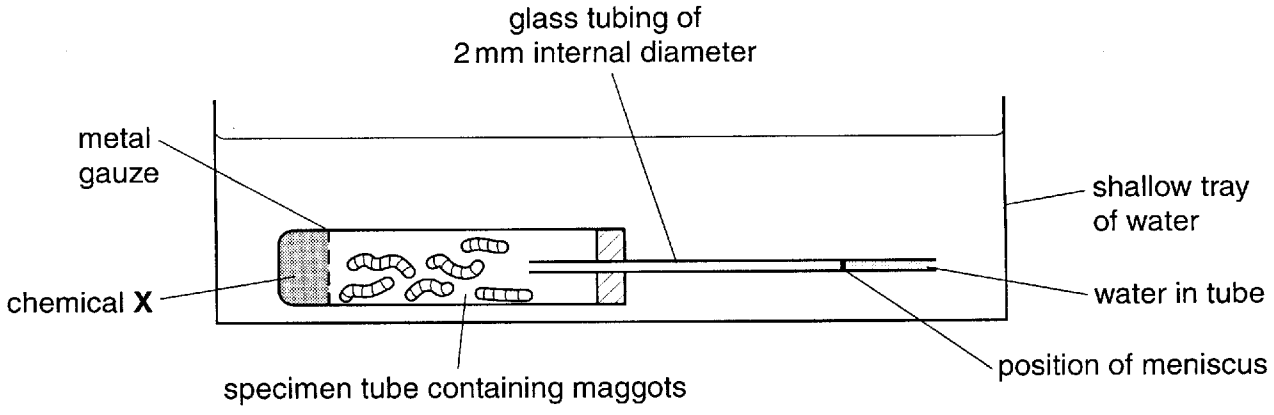

Fig. 1.1

After assembling, the apparatus is lowered into a shallow tray of warm water. The open end of the glass tubing is kept out of the water for 10 minutes. At the end of this period of time the tubing is completely submerged and the position of the meniscus noted. A thermometer is used to monitor the temperature of the water.

(a) Name the chemical **X**.

.....[1]

(b) State the function of this chemical.

.....[1]

(c) Explain why the apparatus is left for 10 minutes before readings are taken.

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.....[2]

A second respirometer, **B**, is set up in exactly the same way as the first, but with glass beads replacing the maggots.

(d) Explain the purpose of this second respirometer.

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.....[2]

Table 1.1 shows a typical set of student results obtained with the respirometers. The student measured the distance moved by the meniscus in **each minute** over a ten minute period.

Table 1.1

respirometer	contents	distance moved by the meniscus in **each minute** / mm									
A	maggots	2.0	2.5	2.0	2.5	2.0	2.0	1.5	2.0	2.0	1.5
B	glass beads	0.5	0.0	0.5	0.0	0.5	0.0	0.0	0.5	0.0	0.0

(e) Calculate the **mean** distance moved by the meniscus per minute in each respirometer.

respirometer **A** .....

respirometer **B** .....[2]

(f) Calculate the mean rate of oxygen uptake by the maggots in $mm^3\ min^{-1}$. Show your working.

The internal diameter of the glass tubing is 2 mm.
πr^2h = volume of a cylinder (r = radius, h = distance)
$\pi = 3.14$

Answer ..... $mm^3\ min^{-1}$ [3]

(g) A second student carried out the same experiment.

State **two** factors, **other than temperature**, that should be controlled to achieve comparable results.

1 .....

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2 .....

.....[2]

(h) State **one** way in which the apparatus should be modified to measure the rate of respiration in leaves **and** give a reason for your answer.

modification .....

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reason .....

.....[2]

(i) State the role of oxygen in respiration.

.....[1]

[Total: 16]

For Examiner's Use

2 The light dependent stage of photosynthesis takes place on thylakoid membranes in chloroplasts. These membranes surround the thylakoid space (lumen) and are arranged into stacks known as grana. Fig. 2.1 is a diagram summarising the processes that take place at the thylakoid membrane.

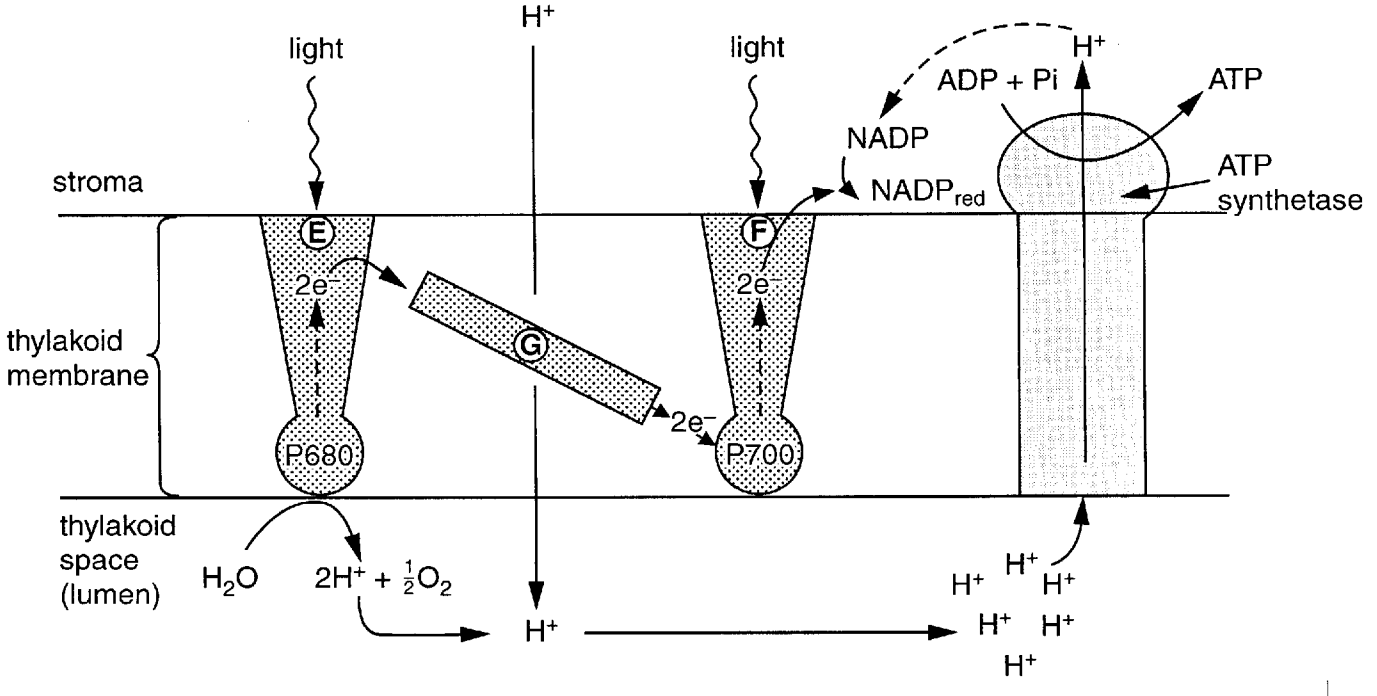

Fig. 2.1

(a) State the general name of the pigment complexes shown as **E** and **F** on the diagram.

.....[1]

(b) Name the pigment represented by P680 and P700.

.....[1]

(c) Name the type of molecule represented by **G**.

.....[1]

(d) State, **using the information in Fig. 2.1**, why the pH of the thylakoid space (lumen) is lower than that of the stroma.

.....[1]

(e) Explain the function of this pH gradient.

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(f) Herbicides (weedkillers), such as diquat and paraquat, act on the chloroplast thylakoids. They interfere with electron transport by accepting electrons and prevent the light dependent stage of photosynthesis from taking place.

Explain how this causes plants to die.

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(g) Some weed species are **not** killed when herbicides are applied.

Suggest why.

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[Total: 14]

3 Fig. 3.1 shows the changes in membrane potential associated with an action potential in a mammalian neurone.

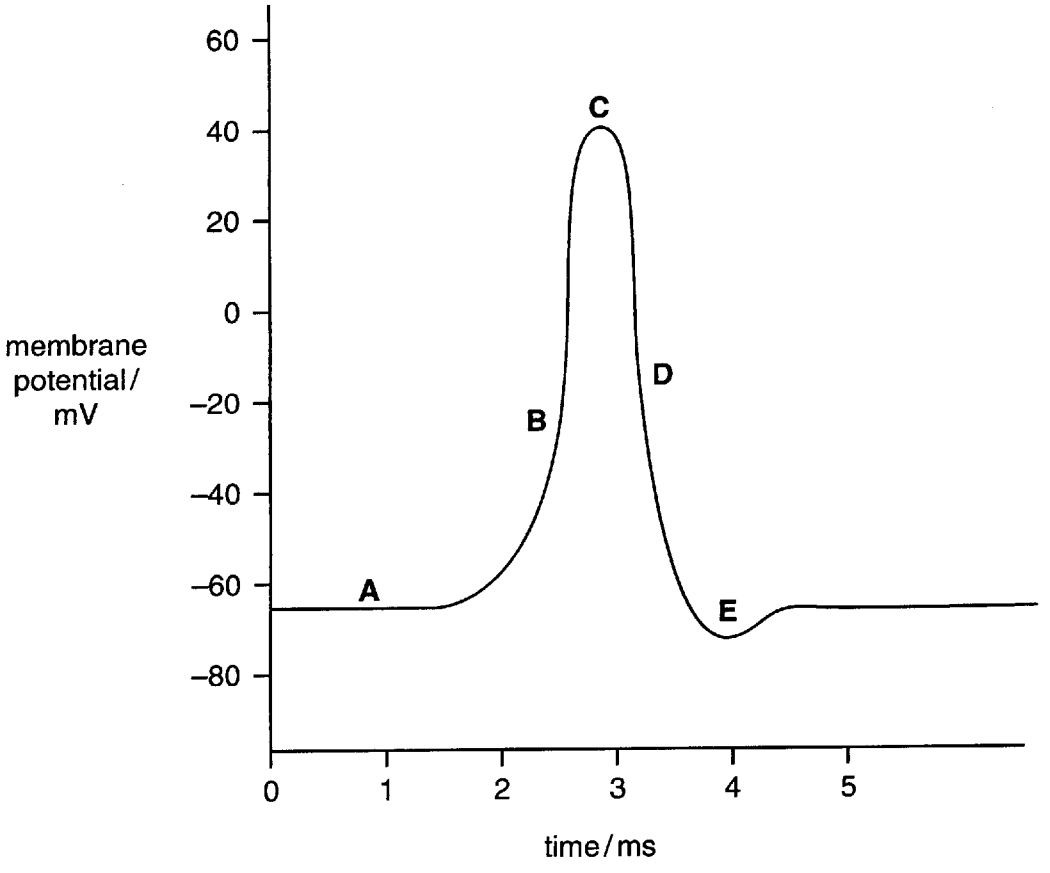

Fig. 3.1

The changes in potential difference are due to the movement of potassium and sodium ions through specific ion channels.

(a) In this question, one mark is available for the quality of written communication.

Describe how movements of sodium and potassium ions across the membrane of a neurone produce an action potential.

Use the letters A to E on Fig. 3.1 to help structure your answer.

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For Examiner's Use

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Quality of Written Communication [1]

(b) Some degenerative diseases, such as multiple sclerosis, are caused by a breakdown of the myelin sheath.

Explain the effect that the breakdown of the myelin sheath will have on the transmission of nerve impulses.

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.....[3]

(c) Describe the role of calcium ions at the synapse.

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[Total: 14]

4 (a) Explain the meaning of the term *species.*

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.....[3]

A recent study of populations of the house mouse, *Mus musculus*, on the island of Madeira resulted in the following observations:

- there are six distinct populations
- the mice are associated with human settlements
- the populations are located in different valleys separated by steep mountains
- each population has a different diploid number of chromosomes.

As a result of these observations, it has been suggested that speciation is taking place.

Fig. 4.1 is a schematic representation of Madeira showing the distribution of the six populations.

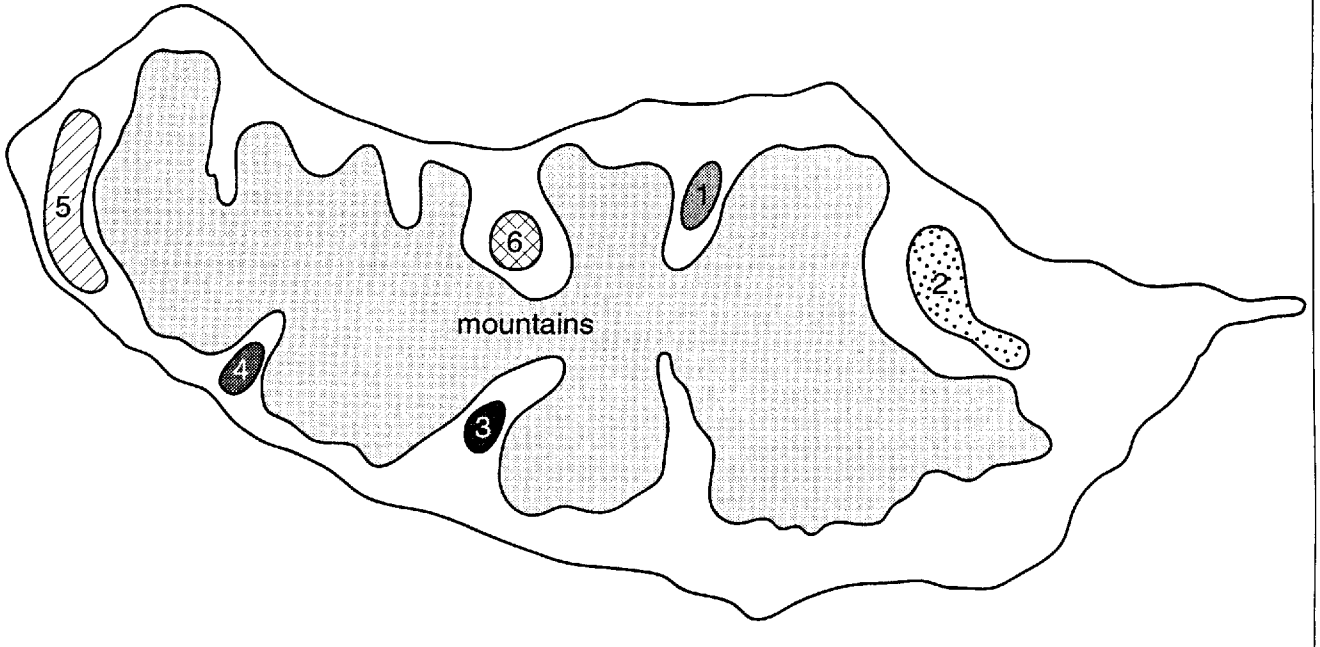

Fig. 4.1

(b) Using the information in Fig. 4.1, state the likely isolating mechanism and the type of speciation taking place.

isolating mechanism .....

type of speciation .....[2]

(c) 'It has been suggested that speciation is taking place.'

Explain how this process is occurring in the house mouse populations of Madeira.

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(d) Explain the likely outcome of individuals from two separate populations being mated in captivity.

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[Total: 14]

5 The bacterium, *Escherichia coli* (*E. coli*), can use either glucose or lactose as a respiratory substrate.

When grown in a medium containing lactose, but no glucose, the genes coding for the enzymes required to utilise lactose are switched on.

These genes are located together in the ***lac* operon** as shown in Fig. 5.1.

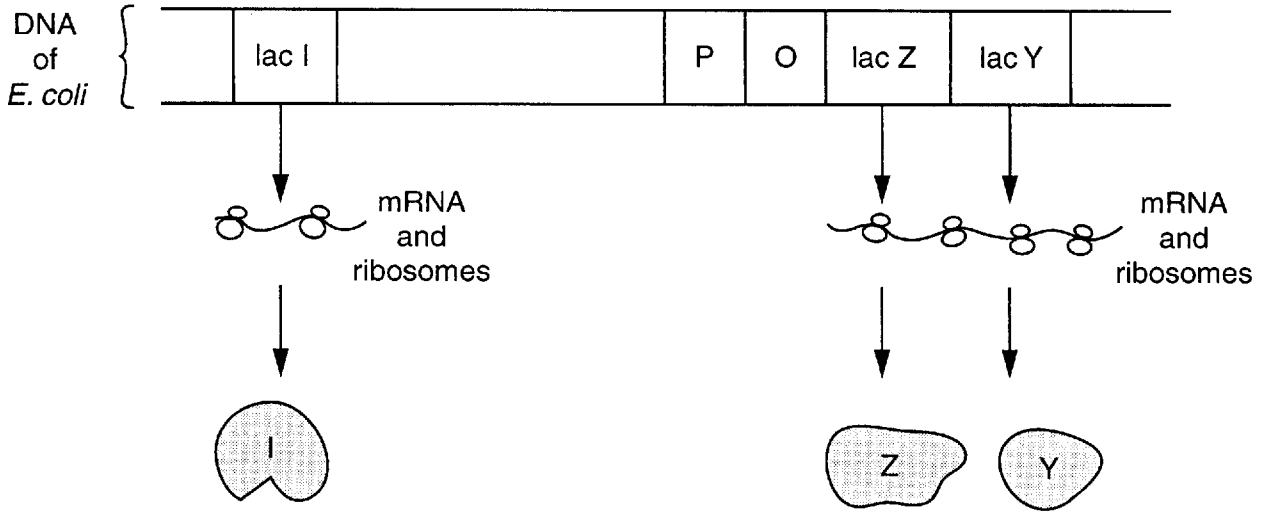

Fig. 5.1

(a) Complete the table below stating the functions of the parts of the *lac* operon. The function of lac I has been done for you.

part of the *lac* operon	function
lac I	controls production of repressor protein
O – operator	
P – promoter	
I – repressor molecule	
Z – beta galactosidase	
Y – lactose permease	

[5]

(b) Explain why beta galactosidase and lactose permease are not produced when lactose is absent.

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(c) Describe the events that occur within *E. coli* when lactose is the only respiratory substrate available.

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[Total: 13]

For Examiner's Use

6 Fig 6.1 is a photograph and an explanatory drawing of part of the cortex of the kidney.

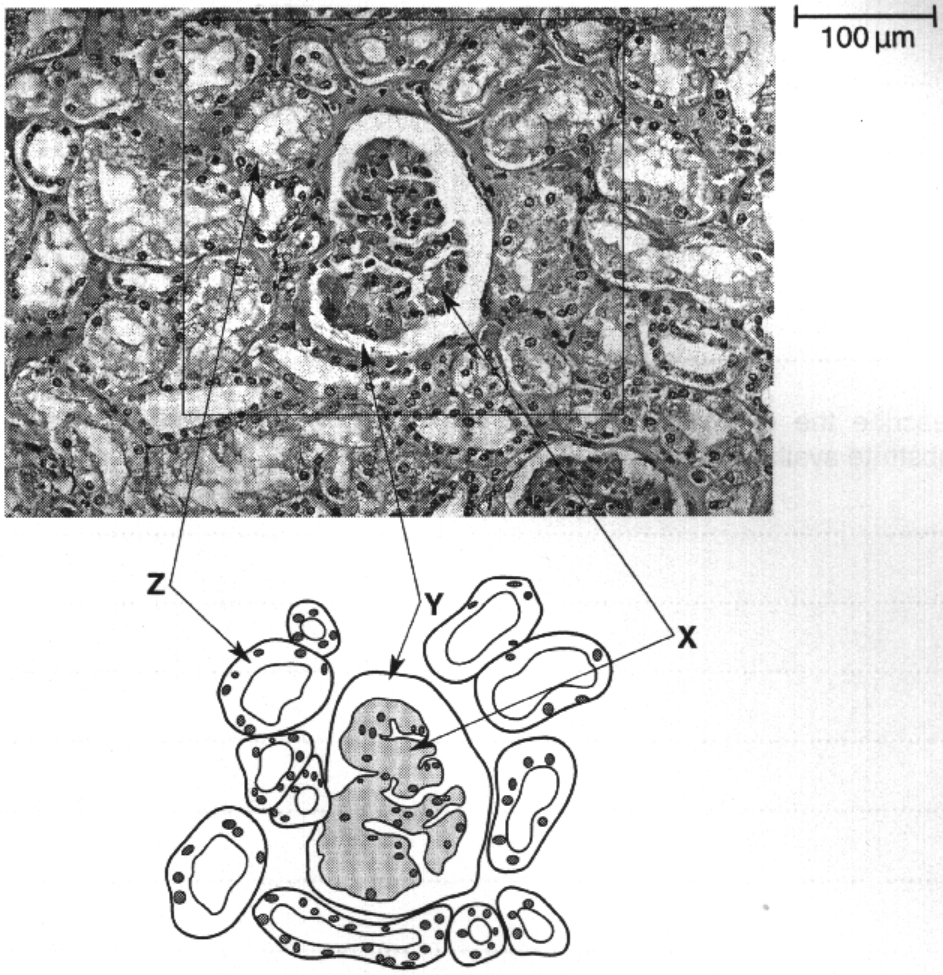

Fig. 6.1

(a) Name the structures **X** to **Z** on Fig. 6.1.

X .....

Y .....

Z .....[3]

(b) In this question, one mark is available for the quality of written communication.

Explain how ultrafiltration takes place in the kidney.

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Quality of Written Communication [1]

[Total: 11]

7 **(a)** In 1991, the European Union adopted the Nitrate Directive. It is an environmental measure to reduce the pollution of water by nitrate.

Name the main source of this nitrate pollution.

.....[1]

(b) In England, the Department for Environment, Food and Rural Affairs (DEFRA) has set down guidelines to help farmers reduce levels of nitrate in water.

Describe the steps farmers can take to help reduce nitrate pollution of water.

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(c) Genetic engineering has been used to produce genetically modified (GM) crops.

Suggest how GM crops could help reduce nitrate pollution.

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[Total: 8]

END OF QUESTION PAPER