

# 2006 Senior External Examination

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## Biological Science

### Paper Two

Thursday 2 November 2006

1.00 pm to 3.10 pm

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### Directions

1. Perusal time: **10 minutes**.  
You may make notes in this paper during perusal time.  
Pages for planning are on the reverse of this cover and on pages 4 and 5.
2. Working time: **2 hours**.
3. Materials provided:
  - response book.
4. Equipment allowed:
  - normal writing implements
  - other QSA-approved equipment.
5. This paper has **five** questions.  
Attempt **all** questions.
6. You may take this paper with you when you leave the examination room.

### Notes

#### Suggested time allocation:

20 minutes for each question

20 minutes reviewing overall responses.

#### Assessment:

This paper assesses the following criterion published in the 1999 Senior External Syllabus in Biological Science:

- Complex reasoning processes (CRP).

The criterion and standards for assessment are on page 6 of this paper.

## Planning space

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All questions are of equal value.

Write your responses in the response book provided.

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### **Question 1**

A new drug has been developed and partly tested by a pharmaceutical company. The drug works against a particular bacterium which has, as one of its effects, an increase in body temperature after an incubation period of three days.

The company would like to market the drug as a tablet to be taken by mouth. However, one group of researchers thinks the drug would be more effective if administered by injection. The drug is available in both forms.

Design a controlled experiment to test the effectiveness of the two methods of giving the drug to volunteers who can be inoculated against the bacterium with the pathogenic bacteria.

Describe the procedure for your experiment, stating the controls you would use, the results that might be possible, how you would obtain your results and what results you would expect if the drug is more effective when administered by injection.

### **Question 2**

An unusual inherited condition is found among certain groups of people, chiefly African Americans and some people from the Mediterranean. The condition is thought to be due to an enzyme deficiency in the red blood cells of the affected individual. In spite of this enzyme deficiency, affected individuals usually appear quite normal, but develop a disease under special circumstances.

The disease results in the destruction of many red blood cells and occurs only when the people are given certain drugs including sulfanilamides, when they inhale the odour of naphthalene (moth balls), or when they eat broad beans or inhale pollen from broad bean plants.

In families that show a history of the condition, it is found that males show severe symptoms of the disease under these special circumstances, but the symptoms shown by females are much milder. A very small proportion of females show severe symptoms.

Present a complete outline of the mode of inheritance of this condition and justify your outline.

### Question 3

Read the following material from a paper written by a high school student studying genetics.

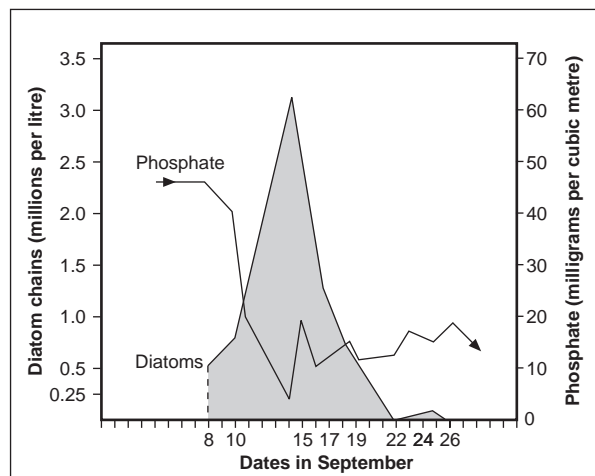
*“Prospects of a cure for cystic fibrosis (CF) have improved dramatically with the successful introduction of a corrective gene into the lungs of experimental rats. The genetic defect that causes cystic fibrosis was discovered in 1989. The faulty gene controls production of a protein that regulates the flow of chloride ions across cell membranes. The cells that line the lungs are particularly sensitive to a defect in this gene, and the result is a build-up of mucus. This encourages frequent bacterial infections, which progressively destroy lung tissue. Most sufferers die before they reach the age of 30.*

*Research has shown that a healthy version of the cystic fibrosis gene can be introduced into the lung tissue of the rats. The cells are then able to produce the key protein normally. This is not ‘curing’ the disease as none of the animals suffer from CF. Research has to be done on how to introduce the healthy gene into the lungs of human sufferers as the lungs continually shed their uppermost cells. One possible method would be to introduce the gene through a virus that is commonly found in the lungs. This genetically engineered virus would make its way into the nuclei of the cells in the lungs. The cell nucleus would then produce the chloride-regulating protein that is missing. The virus would need to be re-introduced at regular intervals as the lining cells are shed.”*

Assuming that the therapy was successful in the treatment of CF in humans, present an analysis of the impact on the human gene pool.

### Question 4

Consider the information revealed by the graph below. It relates to measurements of diatoms and phosphate levels taken from a stream flowing through an industrial area over the month of September. Diatoms are a type of planktonic algae that grow in fresh water locations.



Using the graph, explain what is happening in the stream in terms of what you know about eutrophication. Using this information, suggest an approach you could adopt to overcome this problem.

### Question 5

It is possible that many of the commercial poisons used for the control of such pests as the cabbage moth and codling moth may have side effects such as the destruction of beneficial bacteria and the reduced resistance (or higher tolerance) of pests to these poisons. Predict the long-term consequences of this problem and propose alternative solutions.

## Planning space

## Planning space

## Standards associated with exit levels of achievement

Complex reasoning processes	Very High Achievement	High Achievement	Sound Achievement	Limited Achievement	Very Limited Achievement
	A high ability to use complex reasoning in challenging situations involving the candidate's understanding of subject matter and a high ability to use scientific processes at an advanced level.	Competence in using complex reasoning in challenging situations involving the candidate's understand of subject matter and competence in using scientific processes at an advanced level.	Some success in using complex reasoning in challenging situations involving the candidate's understanding of subject matter and some success in using scientific processes at an advanced level.		



