Cambridge Pre-U

Cambridge International Examinations
Cambridge Pre-U Certificate

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3193605173

BIOLOGY (PRINCIPAL) **9790/03**

Paper 3 Case Study and Synoptic Essay **May/June 2016**

1 hour 45 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer **one** question.
Write your answer on the Question Paper.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
4	
5	
6	
Total	

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

This document consists of **12** printed pages.

CAMBRIDGE International Examinations

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Section A – Case Study

Read the passages carefully and answer **all** the questions.

You are advised to spend no more than 50 minutes on this section.

1 Cystic fibrosis (CF) is a serious genetic condition caused by recessive mutations in the gene for the CF transmembrane conductance regulator protein (CFTR). One of the most common mutated alleles of this gene is known as Δ*F508.*

Features of CF include:

- a reduction in water loss through epithelial cell membranes
- a reduction in sweating.

(a) Describe how a mutation in the *CFTR* gene may bring about changes in water transport across epithelial membranes.

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(b) Explain why inherited diseases have a low occurrence in the general population.

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(c) CF is one of the most common inherited diseases. This unusually high occurrence has given rise to the suggestion that carriers of the Δ*F508* allele may have a selective advantage over non-carriers.

Approximately 1 in 30 people in the European and North American populations are carriers of the defective allele Δ*F508*.

Within the European and North American populations, calculate the probability that a newly-born baby will be homozygous for this allele.

You should show your working.

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[Total: 10]

2 Cholera is caused by a toxin secreted by the bacterium *Vibrio cholerae* in the gut. This toxin acts on CFTR protein and increases water loss from the gut epithelial cells. This results in severe diarrhoea and may lead to death if untreated.

In an experiment carried out in 1994, it was shown that when mice that were heterozygous for Δ*F508* were exposed to cholera toxin, they lost 50% less water than homozygous dominant mice also exposed to cholera toxin.

This supported a suggestion that the selective advantage of carrying the Δ*F508* allele may be protection from the effects of cholera.

(a) Suggest how the Δ*F508* allele might be expected to convey a selective advantage in areas of the world where cholera is common.

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(b) In 2000, a further experiment to investigate the possible link between the Δ*F508* allele and the severity of cholera in humans was conducted. To do this, the effect of prostaglandin was measured in fifteen human subjects including:

- some who had cystic fibrosis (homozygous for Δ*F508*)
- some who were carriers (heterozygous for Δ*F508*)
- a control group who did not have cystic fibrosis and did not carry Δ*F508*.

Prostaglandin is a chemical that increases water loss from epithelial cells by increasing chloride secretion through the CFTR protein.

The results are shown in Fig. 2.1.

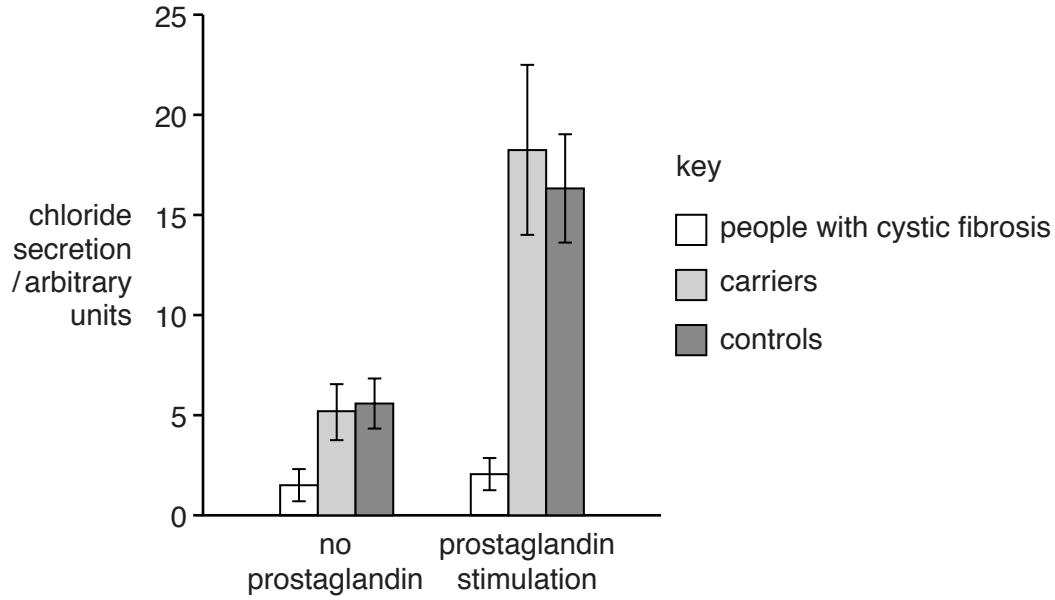

Fig. 2.1

(i) Describe the results obtained in the study carried out in 2000.

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(ii) Explain why a chemical (prostaglandin) was used to increase water loss from epithelial cells in the 2000 study.

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(iii) Comment on the difference in results obtained in the studies carried out in 1994 and 2000.

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[Total: 15]

3 **(a)** In Europe and North America, where the frequency of the Δ*F508* allele is relatively high, there are now very few cases of cholera.

In the past, cholera was very common throughout Europe.

Suggest how this may explain the present day frequency of the Δ*F508* allele in Europe.

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(b) In parts of Asia and Africa with hot climates, there are many cases of cholera but the frequency of the Δ*F508* allele is relatively low.

Some scientists have therefore suggested that the distribution of the Δ*F508* allele is related to temperature, as well as the incidence of cholera.

Suggest an explanation for the relatively low occurrence of the Δ*F508* allele in hot climates.

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[Total: 5]

Section B – Synoptic Essay

Answer **one** question on the lined paper that follows.

You are advised to spend no more than 50 minutes on this section.

Choose **one** question from Question 4, Question 5 or Question 6.

4 'A human's genome is constant, whereas the proteome of a human is constantly changing.'

Discuss this statement including reference to its medical implications.

5 'The growth of a plant is genetically predetermined.'

Discuss the extent to which this statement is true.

6 Discuss why the concept of the niche is so important in environmental studies.

Your answer should draw from a wide range of syllabus material and also demonstrate evidence of reading around the subject. [30]

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