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**9790/03**

**May/June 2016**

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	
<b>Total</b>	

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.

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

- [3]

- (c) CF is one of the most common inherited diseases. This unusually high occurrence has given rise to the suggestion that carriers of the  $\Delta F508$  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  $\Delta F508$ .

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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.....[2]

**[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  $\Delta F508$  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  $\Delta F508$  allele may be protection from the effects of cholera.

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

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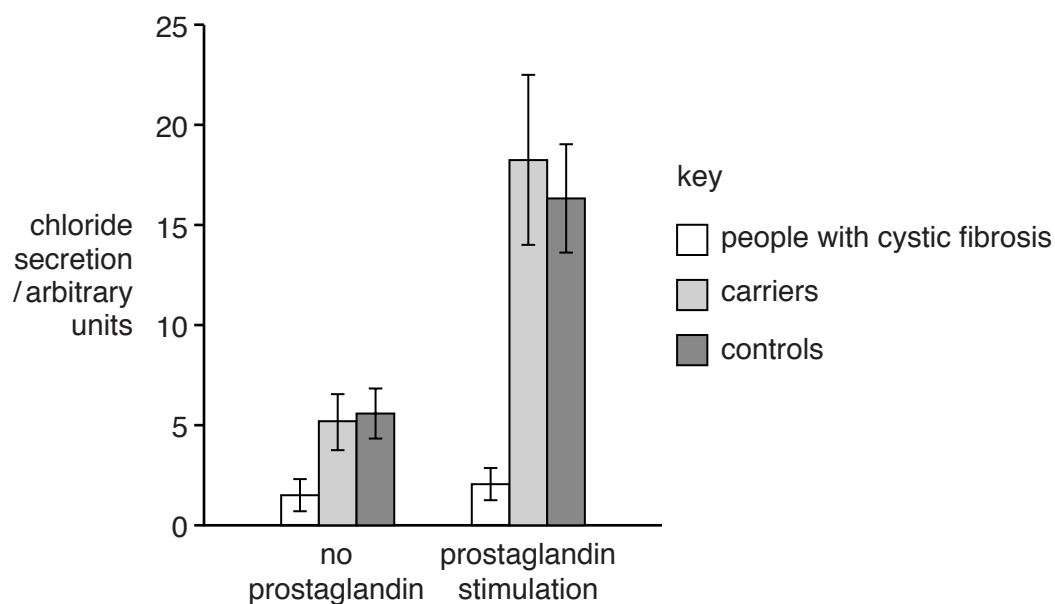
.....[5]

(b) In 2000, a further experiment to investigate the possible link between the  $\Delta F508$  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  $\Delta F508$ )
- some who were carriers (heterozygous for  $\Delta F508$ )
- a control group who did not have cystic fibrosis and did not carry  $\Delta F508$ .

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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.....[3]

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

[2]

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

[5]

**[Total: 15]**

- 3 (a) In Europe and North America, where the frequency of the  $\Delta F508$  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  $\Delta F508$  allele in Europe.

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.....[2]

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

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

Suggest an explanation for the relatively low occurrence of the  $\Delta F508$  allele in hot climates.

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.....[3]

[Total: 5]

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

- Discuss this statement including reference to its medical implications.

- 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]

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dashed lines, providing a guide for letter height and placement. The lines are evenly spaced across the entire page, which is otherwise blank.









[Total: 30]

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