



MINISTRY OF EDUCATION, SINGAPORE
in collaboration with
CAMBRIDGE INTERNATIONAL EDUCATION
General Certificate of Education Advanced Level

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BIOLOGY

9816/01

Paper 1

For examination from 2026

SPECIMEN PAPER

2 hours 30 minutes

You must answer on the question paper.

You will need: Insert

INSTRUCTIONS

- Section A: answer **all** questions.
- Section B: answer **one** question.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and index number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen. Do **not** use correction fluid or tape.
- Do **not** write on any bar codes.
- You may use an approved calculator.

INFORMATION

- The total mark for this paper is 100.
- The number of marks for each question or part question is shown in brackets [].
- The insert contains information for Question 1.

This document has **18** pages.



Singapore Examinations and Assessment Board



CAMBRIDGE
International Education

Section A

Answer **all** the questions in this section.

- 1 You should read through the whole of the insert and **Question 1** carefully and then use the information provided to answer the questions. The insert includes Table 1.1, Table 1.2, Figure 1.1 and Figure 1.2.

The entire question is based upon the cystic fibrosis transmembrane conductance regulator glycoprotein (CFTR), which is coded for by the *CFTR* gene. CFTR forms an ion channel.

- (a) (i) Using the data in Table 1.1 in the insert, complete Table 1.3 to show the probability that a child of African-American parents will be born with cystic fibrosis.

For this calculation, you should assume that no individuals with cystic fibrosis have children and that no new mutations occur.

Table 1.3

ethnic group	probability of child being born with cystic fibrosis
Ashkenazi Jews	1 in 2304
European / North American	1 in 2500
African–American	1 in
Asian	1 in 35 344

[1]

- (ii) Use the data in Table 1.3 to predict the expected percentage of people who are carriers for cystic fibrosis in the European / North American ethnic group.

You should assume that the European / North American ethnic group represents a population that is in Hardy–Weinberg equilibrium.

Give your answer to **three** significant figures.

Show your working.

expected percentage of carriers for cystic fibrosis =% [2]

- (iii) In the European / North American ethnic group, the percentage of people who are carriers for cystic fibrosis is 4.00%.

Statistically, this is significantly different to the percentage calculated in 1(a)(ii).

Explain why the percentage of people who are carriers for cystic fibrosis in the European / North American ethnic group is different to the percentage expected for a population in Hardy–Weinberg equilibrium, as calculated in 1(a)(ii).

Your explanation should account for the direction of the difference (larger or smaller).

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.....[2]

- (b) Using Figure 1.2 in the insert, calculate the percentage of the more common gene mutations that only occur in two ethnic groups.

percentage of mutations =% [1]

(c) With reference to Table 1.1 and Figure 1.2, suggest possible explanations to account for the differences between the four ethnic groups in the:

- frequency of carriers of cystic fibrosis
- occurrence of different *CFTR* mutations.

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[5]

(d) There are approximately 1500 different mutations of the *CFTR* gene.

Estimate the number of different genotypes for individuals who have two mutated *CFTR* alleles **and** explain your reasoning.

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[2]

- (e) Some mutations of the *CFTR* gene result in an individual having complete loss of functionality of CFTR. Other mutations have less significant effects.

Suggest **and** explain how mutations may result in an individual having complete loss of functionality of CFTR.

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..... [4]

- (f) With reference to Figure 1.1 in the insert, suggest **and** describe a mechanism for the effects of the release of cAMP on the opening of the CFTR ion channel, following infection by *V. cholerae*.

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(g) Use the information provided to make deductions about the possible structure and properties of the cell surface membrane receptor that binds to the cholera toxin.

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..... [3]

[Total: 25]

2 In April 1815, the volcano Mount Tambora in Sumbawa (Indonesia) erupted.

- Ash fell up to 1300 km away.
- Small ash particles remained in the atmosphere around the world for up to three years.
- The sky became red due to a major release of sulfates into the upper atmosphere.
- Solar radiation was reflected back into space and, over the next three years, mean land temperatures in the Northern Hemisphere fell by up to 2 °C.
- In 1816, known as the 'year without a summer', the night temperatures in temperate regions of North America and Europe fell below 0 °C on several occasions in the hottest months of the year.
- The decade of 1811–1820 was the coldest decade on record.

A student suggested that while the effects of a large volcanic eruption could be harmful to plants and animals and result in a reduction in biocapacity, the event could mitigate some of the effects of global warming.

Discuss the validity of the student's suggestion with respect to:

- the possible harmful effects on plants and animals
- how biocapacity could be affected
- the extent to which a large volcanic eruption could mitigate the effects of global warming.

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Section B

Answer **one** question in this section.

Either

3 All living organisms need to synthesise ATP.

Discuss the similarities and differences between the ways in which organisms synthesise ATP.

[25]

Or

4 Despite all of the recent advances in biology, humans continue to suffer from disease.

Discuss why elimination of all human diseases is unlikely to occur.

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