Diploma Programme
Programme du diplôme
Programa del Diploma

Biology
Standard level
Paper 2

Wednesday 6 May 2015 (morning)

1 hour 15 minutes

Candidate session number

Instructions to candidates

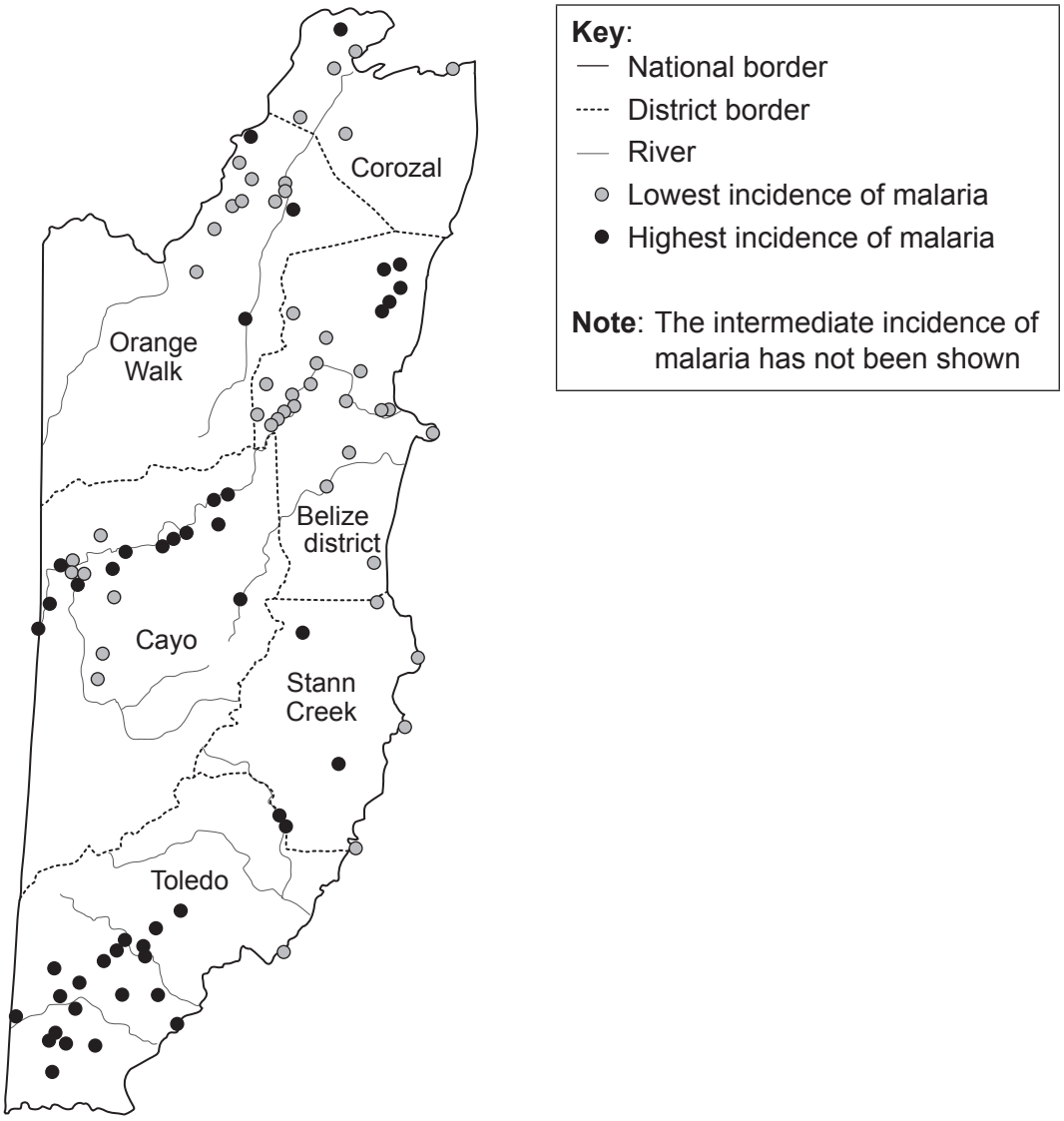
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer one question.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[50 marks]**.

2215–6017

Section A

Answer **all** questions. Write your answers in the boxes provided.

1. Malaria is a mosquito-borne disease caused by a unicellular organism, *Plasmodium*. *Plasmodium* is a parasite that spends part of its life in a mosquito and part in a human. The mosquito transmits the *Plasmodium* to a human when it feeds on human blood. Mosquitoes hatch in water and are flying insects as adults. In the country of Belize, where malaria is a serious problem, studies have been made to determine what environmental factors affect the incidence of the disease. 156 villages were studied over a ten-year period.



[Source: adapted from S. Hakre *et al.* (2004) *International Journal of Health Geographics*, **3** (6). Spatial correlations of mapped malaria rates with environmental factors in Belize, Central America. Shilpa Hakre, Penny Masuoka, Errol Vanzie and Donald R. Roberts © 2004 Hakre *et al*; licensee BioMed Central Ltd]

(This question continues on the following page)

(Question 1 continued)

(a) State the district where there is the highest number of villages with the highest incidence of malaria. [1]

. . . . . .

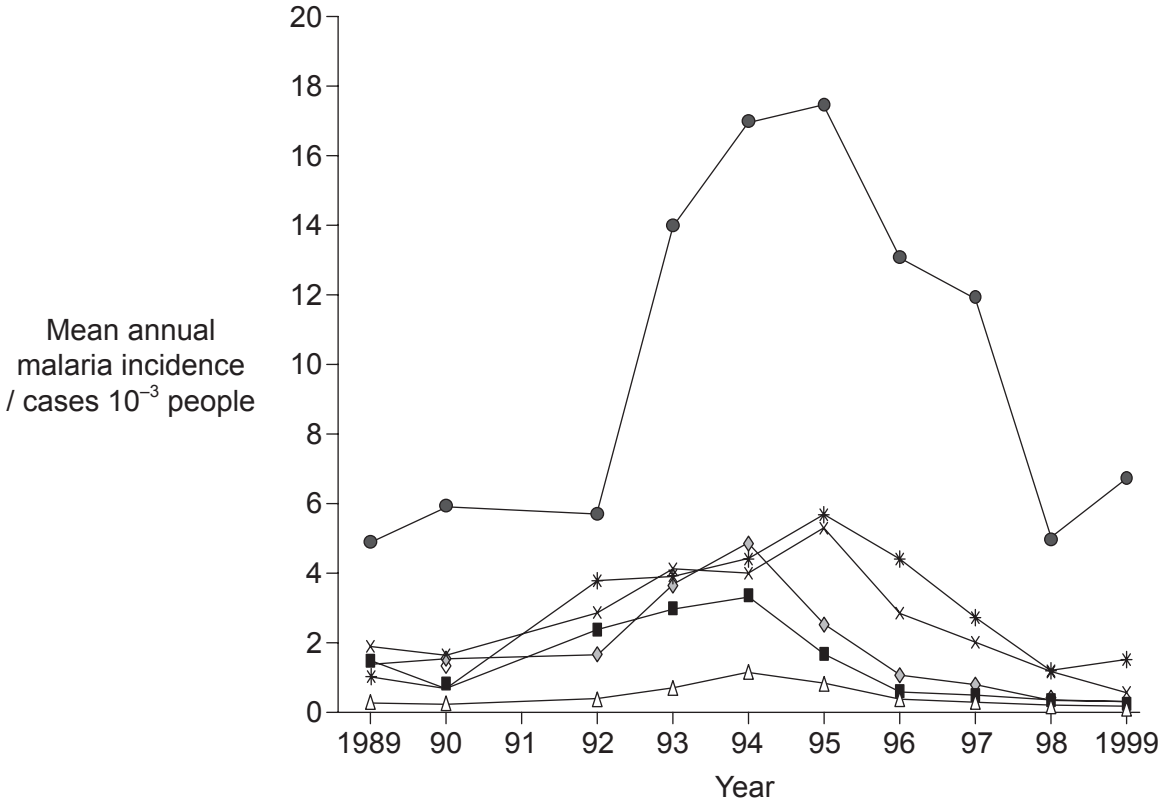
(b) Analyse the data in the map to find whether there is an association between rivers and the incidence of malaria. [2]

. . . . . .
. . . . . .
. . . . . .
. . . . . .

(This question continues on the following page)

(Question 1 continued)

Each of the six districts of Belize was studied from 1989 to 1999. The graph shows the mean number of people in each district to be affected by malaria per year per 1000 people.



[Source: adapted from S. Hakre *et al.* (2004) *International Journal of Health Geographics*, **3** (6). Spatial correlations of mapped malaria rates with environmental factors in Belize, Central America. Shilpa Hakre, Penny Masuoka, Errol Vanzie and Donald R. Roberts © 2004 Hakre *et al*; licensee BioMed Central Ltd]

(c) Compare the trends in incidence of malaria for Toledo and Corozal. [3]

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(This question continues on the following page)

(Question 1 continued)

(d) (i) Suggest a reason for the decreases in the incidence of malaria from 1995 to 1999. [1]

. . . . . .
. . . . . .
. . . . . .
. . . . . .

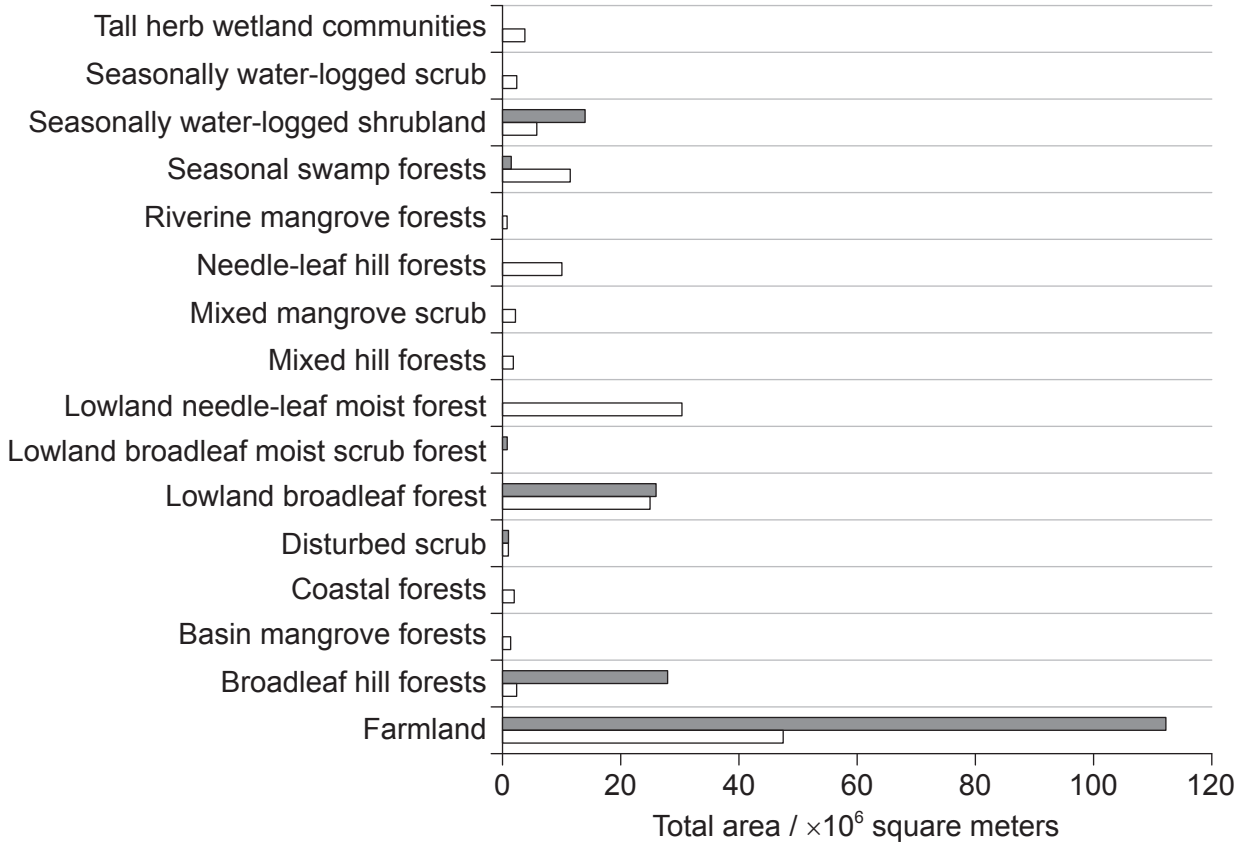
(ii) Suggest a reason why the incidence of malaria is so low in the Belize District. [1]

. . . . . .
. . . . . .
. . . . . .
. . . . . .

(This question continues on the following page)

(Question 1 continued)

The country of Belize has many different ecosystems. These ecosystems are shown in the bar chart. The white bars indicate the total area within each ecosystem with the lowest incidence of malaria. The dark grey bars indicate the total area within each ecosystem with the highest incidence of malaria. The total area with an intermediate incidence of malaria is not shown.



[Source: adapted from S. Hakre *et al.* (2004) *International Journal of Health Geographics*, **3** (6). Spatial correlations of mapped malaria rates with environmental factors in Belize, Central America. Shilpa Hakre, Penny Masuoka, Errol Vanzie and Donald R. Roberts © 2004 Hakre *et al*; licensee BioMed Central Ltd]

(e) Besides farmland, identify which **two** ecosystems have the greatest total area with a high incidence of malaria. [1]

. . . . . .

. . . . . .

(This question continues on the following page)

(Question 1 continued)

(f) Predict with a reason, using the data, which district has most farmland. [1]

. . . . . .
. . . . . .

(g) Discuss whether malaria could be reduced by replacing farmland with natural ecosystems and replacing broadleaf hill forest with mixed hill forest. [4]

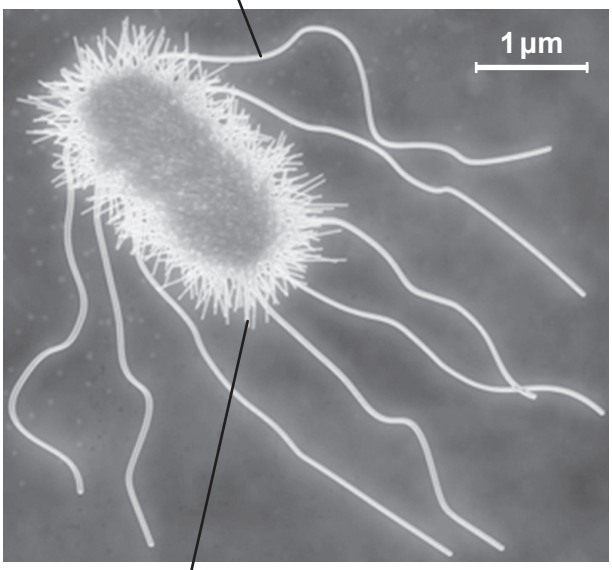
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

2. (a) Outline the cell theory. [2]

. . . . . .
. . . . . .
. . . . . .
. . . . . .

(b) (i) Annotate the electron micrograph of the *Escherichia coli* cell with the function of the structures labelled I and II. [2]

I: . . . . . .



II: . . . . . .

[Source: National Research Council, Canada]

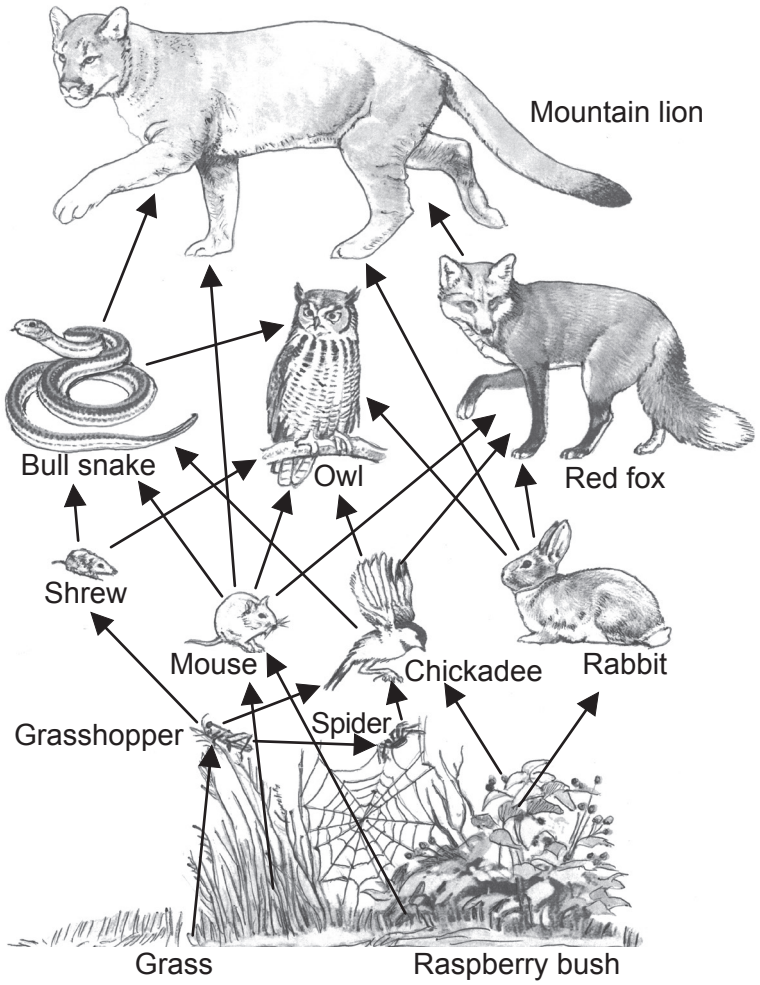
(ii) Calculate the magnification of the electron micrograph. [1]

. . . . . .

Please **do not** write on this page.

Answers written on this page
will not be marked.

3. The image shows a forest food web from North America.



[Source: adapted from *BSCS Biology: An Ecological Approach*, Figure 1.10, page 12]

(a) Describe what is meant by a food chain. [2]

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(This question continues on the following page)

(Question 3 continued)

(b) (i) Identify a food chain with four or more organisms from the forest food web. [1]

(ii) Deduce the trophic level of each organism identified in your food chain from (b)(i). [1]

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(c) State **one** reason that the population of mountain lions is smaller than the populations of other animals in the food web. [1]

. . . . . .
. . . . . .

4. (a) Define *pathogen*. [1]

. . . . . .
. . . . . .

(b) Explain antibody production. [3]

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(c) Explain why antibiotics are effective against bacterial diseases but not against viral diseases. [2]

. . . . . .
. . . . . .
. . . . . .
. . . . . .

Section B

Answer **one** question. Up to two additional marks are available for the construction of your answer. Write your answers in the boxes provided.

5. (a) Describe the genetic code and its relationship to polypeptides and proteins. [5]

(b) Outline the role of proteins in active and passive transport of molecules through membranes. [5]

(c) Many cell functions, like synthesis of macromolecules and transport, require energy in the form of ATP. Explain how ATP is generated in animal cells. [8]

6. (a) Meiosis in humans produces cells that participate in fertilization. Outline the processes involved in meiosis. [5]

(b) Following fertilization, cells in the developing embryo differentiate. Outline a technique for cloning using differentiated animal cells. [5]

(c) Discuss ethical issues of therapeutic cloning in humans. [8]

7. (a) Draw a labelled diagram of the human heart showing the attached blood vessels. [6]

(b) Describe the action of the heart in pumping blood. [5]

(c) Nerves connecting the brain and heart contain neurons that control heart rate. Explain how a nerve message passes from one neuron to another neuron. [7]