IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

M06/4/BIOLO/SP2/ENG/TZ2/XX+

22066017

BIOLOGY
STANDARD LEVEL
PAPER 2

Thursday 4 May 2006 (afternoon)

1 hour 15 minutes

Candidate session number

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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 of Section A in the spaces provided.
- Section B: answer one question from Section B. Write your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the numbers of the questions answered in the candidate box on your cover sheet and indicate the number of sheets used in the appropriate box on your cover sheet.

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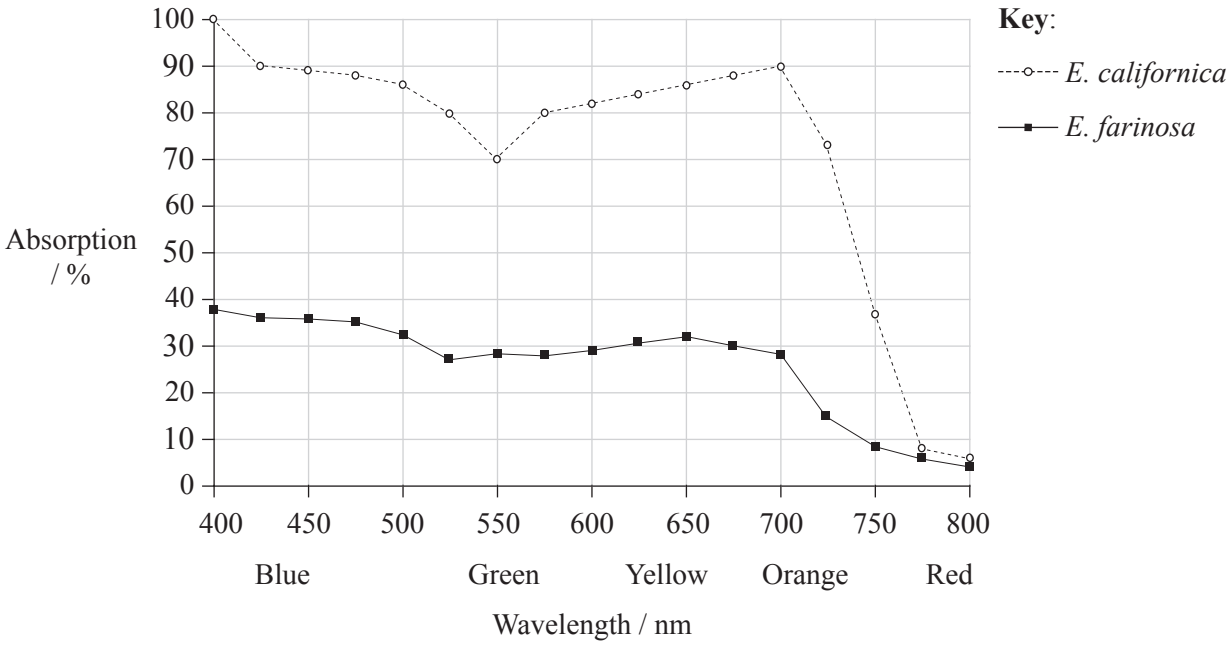
SECTION A

*Answer **all** the questions in the spaces provided.*

1. Plants that grow in the desert have many adaptations that enable them to cope with full sunlight and low water availability, such as thicker leaves with reduced surface area. Researchers have also observed that leaf pubescence (presence of white leaf surface hairs) may be another adaptation to dry environments. A study was done to evaluate the effects of leaf pubescence on two species of Californian plants, *Encelia farinosa*, a desert species with pubescent leaves and *Encelia californica*, a native of the moist coast with non-pubescent leaves.

The graph below shows the absorption spectrum of intact leaves of both species in the photosynthetically active spectrum between the wavelengths 400 nm (blue light) and 800 nm (red light) of light.



[Reprinted with permission from Science, Ehleringer *et al.*, (1976), **192**, pp 376–377. Copyright 1976 AAAS]

(a) Calculate the difference in absorption between *E. farinosa* and *E. californica* at 600 nm. *[1]*

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(b) Suggest a possible explanation for the decrease in absorption at 550 nm for *E. californica*. *[1]*

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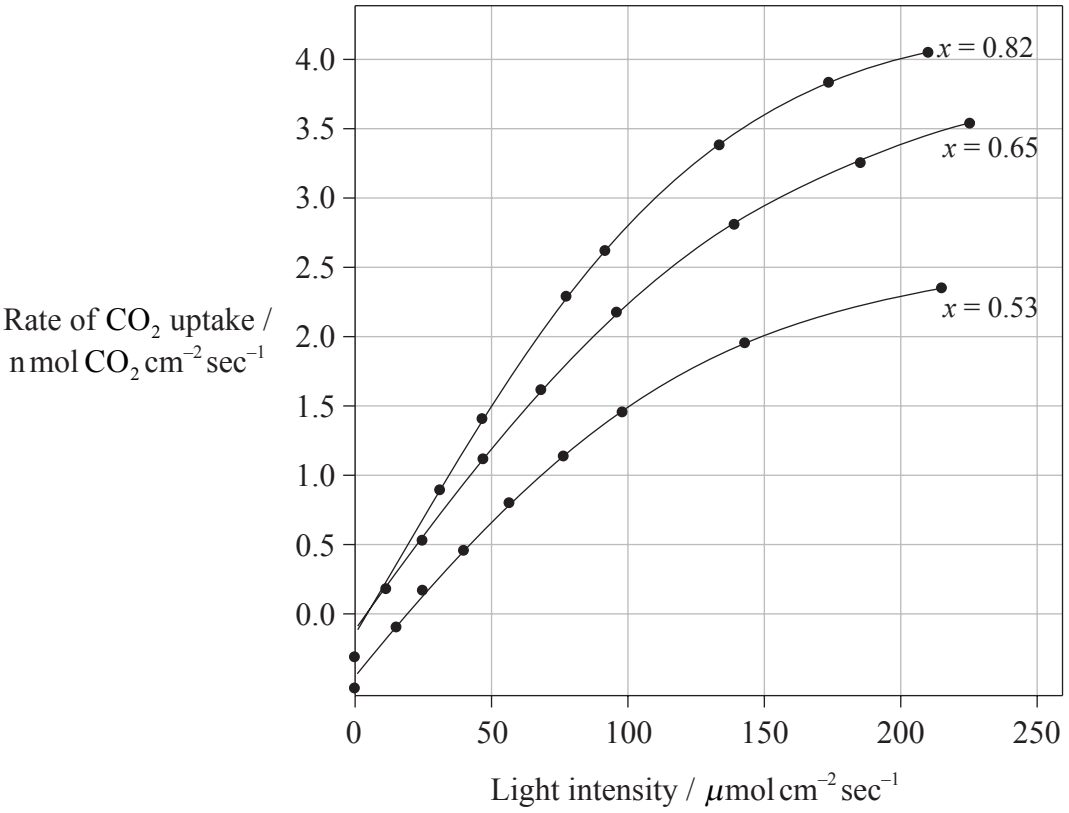
(Question 1 continued)

The following graph shows the rate of CO_2 uptake of three leaves of *Encelia farinosa* with different absorbance coefficients (x) (proportion of light absorbed) which is related to the degree of pubescence of the leaf. The higher the coefficient the more light is absorbed.



[Source: Ehleringer, *et al.*, *Science*, (1976), **192**, pp 376–377]

(c) Using the graph above, compare the maximum CO_2 uptake of *E. farinosa* at absorbance coefficients 0.82 and 0.53. *[1]*

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(d) (i) Using the data, deduce the relationship between pubescence and light absorption. *[1]*

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(ii) Evaluate the relationship of leaf pubescence and CO_2 uptake. *[1]*

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(Question 1 continued)

(e) Suggest how natural selection may have caused the difference in leaf pubescence between *E. farinosa* and *E. californica.* *[1]*

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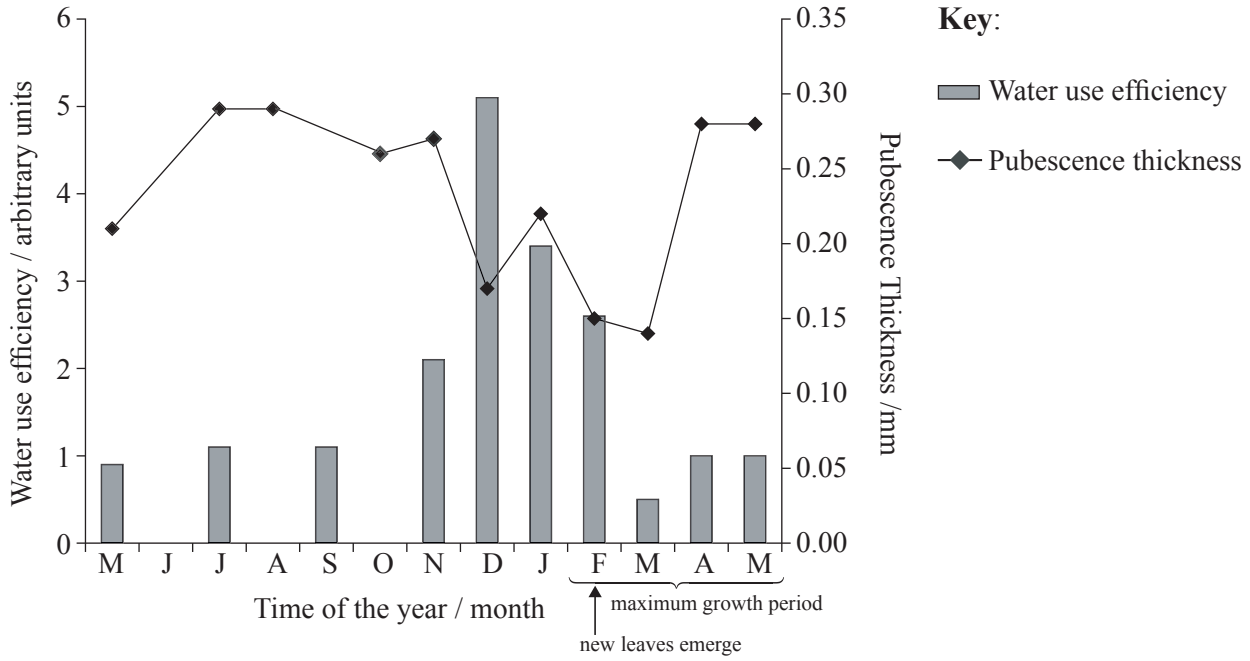
(Question 1 continued)

Further research was carried out to evaluate the relationship between leaf pubescence during the growing season of *E. farinosa* and its water use efficiency. Water use efficiency is defined as the amount of CO_2 uptake divided by the amount of water lost by transpiration from the leaf. The graph below shows the seasonal change in leaf pubescence and water use efficiency of *E. farinosa*. The period of maximum growth is indicated on the graph. During the course of the year the optimum temperature for photosynthesis remains at 30˚C while the air temperature fluctuates from a high of 38˚C in the summer months (May-September) to a low of 8˚C during the winter months (December-February).



[Source: Smith and Nobel, *Ecology*, (1977), **58**, pp 1033–1043]

(f) State the month with the highest water use efficiency. *[1]*

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(g) Outline the changes in leaf pubescence of *E. farinosa* during the year. *[2]*

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(Question 1 continued)

(h) Analyse the change in the level of water use efficiency between July and December for *E. farinosa*. *[2]*

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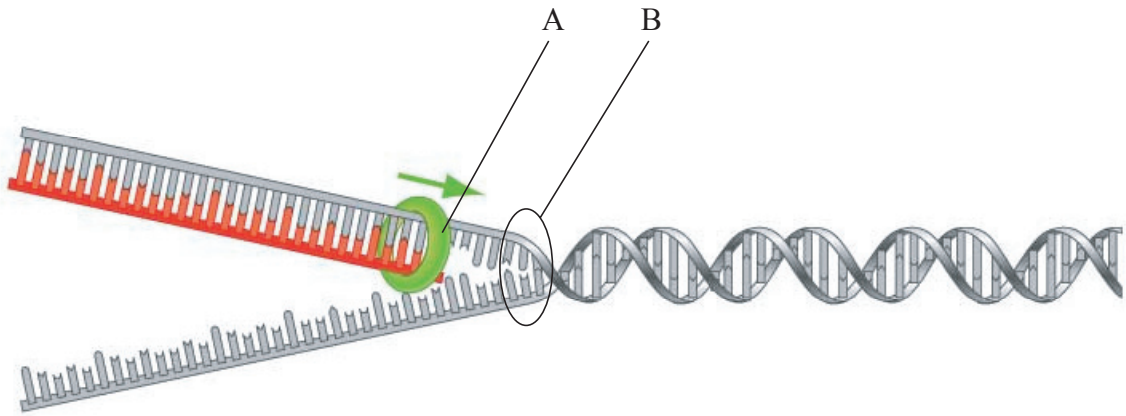
2. The following diagram represents replication in DNA.



[Freeman, Scott, Biological Science, 1st, © 2002. Electronically reproduced by permission of Pearson Education, Inc., Upper Saddle River, New Jersey]

(a) State the name and describe the function for the enzymes labelled A and B on the diagram. *[2]*

(i) A: Name: . . . . . .

Function: . . . . . .

(ii) B: Name: . . . . . .

Function: . . . . . .

(b) Identify the cellular location of DNA replication in eukaryotic cells. *[1]*

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(c) State at which period during the cell cycle DNA replication occurs. *[1]*

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(d) Explain the significance of complementary base pairing during DNA replication. *[2]*

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3. (a) List **two** functions of membrane proteins. *[1]*

1. . . . . .

2. . . . . .

(b) Oxygen (O_2) moves across the membrane by diffusion. Define the term *diffusion*. *[1]*

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(c) Potassium can move across the membrane by passive or active transport. Distinguish between active transport and facilitated diffusion of ions. *[2]*

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(d) The hormone insulin leaves the cell by exocytosis. Describe the process of exocytosis. *[2]*

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4. (a) (i) Define the term *homeostasis*. *[1]*

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(ii) State which **two** systems are involved in the control of homeostasis. *[1]*

1. . . . . .

2. . . . . .

(b) Describe the roles of the kidney in homeostasis. *[2]*

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(c) Using an example, explain the role of negative feedback in homeostasis. *[3]*

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SECTION B

*Answer **one** question. Up to two additional marks are available for the construction of your answer. Write your answers on the answer sheets provided. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.*

5. (a) Draw a diagram of the heart showing the chambers, valves and associated blood vessels. *[4]*

(b) Outline the control of the heartbeat. *[6]*

(c) Explain the relationship between the structure and function of blood vessels that are found in a human. *[8]*

6. (a) Outline how the process of meiosis can lead to Down's Syndrome. *[4]*

(b) Discuss the advantages and disadvantages of genetic screening for chromosomal and genetic disorders. *[8]*

(c) Describe the technique for the transfer of the insulin gene using *E. coli*. *[6]*

7. (a) Distinguish between **one** technique used to estimate the size of plant populations and another to estimate the size of animal populations. *[6]*

(b) Draw an annotated population growth curve for an animal introduced into a new environment. *[4]*

(c) With reference to **one** example, discuss the theory of evolution by natural selection. *[8]*