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

N06/4/BIOLO/HP2/ENG/TZ0/XX

88066002

BIOLOGY
HIGHER LEVEL
PAPER 2

Thursday 16 November 2006 (afternoon)

2 hours 15 minutes

Candidate session number

0	0							

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 two questions 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.

0109

SECTION A

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

1. Plants native to warm climates sometimes suffer injuries when exposed to relatively low temperatures. For example, temperatures in the range of 10°C to 15°C can cause "chilling injuries" to some sub-tropical plants that normally grow between 20°C and 25°C. These "chilling injuries" may affect gene expression and reduce the rates of photosynthesis and protein synthesis. Some plants are more resistant to "chilling injuries" than others.

These injuries could be due to damaged membranes. Membrane lipids consist of a mixture of saturated fatty acids (no double bonds) and unsaturated fatty acids (one or more double bonds). Saturated fatty acids have a higher melting point than unsaturated fatty acids.

The table below shows the main fatty acid composition (as a percentage of the total fatty acid content) of mitochondrial membranes in various plants and the ratio of unsaturated/saturated fatty acids.

		Fatty acid composition / %					
		Chill-resistant plants			**Chill-sensitive plants**		
Fatty acid	Number of double bonds	Cauliflower	Turnip	Pea	Bean	Sweet potato	Maize
Palmitic	0	21.3	19.0	12.8	24.0	24.9	28.3
Stearic	0	1.9	1.1	2.9	2.2	2.6	1.6
Oleic	1	7.0	12.2	3.1	3.8	0.6	4.6
Linoleic	2	16.4	20.6	61.9	43.6	50.8	54.6
Linolenic	3	49.4	44.9	13.2	24.3	10.6	6.8
Ratio of unsaturated to saturated fatty acids		3.2 : 1	3.9 : 1	3.8 : 1	2.8 : 1	1.7 : 1	2.1 : 1

[Source: A C Terry *et al*, *Plant physiology 2000*, **124**, pages 183–190,
]

(a) Identify,

(i) the plant with the lowest ratio of unsaturated fatty acids to saturated fatty acids. *[1]*

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(ii) which saturated fatty acid has the highest percentage composition. *[1]*

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(This question continues on the following page)

(Question 1 continued)

(b) Deduce which data in the table determines whether a plant is **either** chill resistant **or** chill sensitive. *[2]*

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(c) Suggest which physical property of mitochondrial membranes allows some plants to be chill resistant. *[1]*

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(d) Predict how the function of the mitochondria will be affected when chill sensitive plants are cooled. *[1]*

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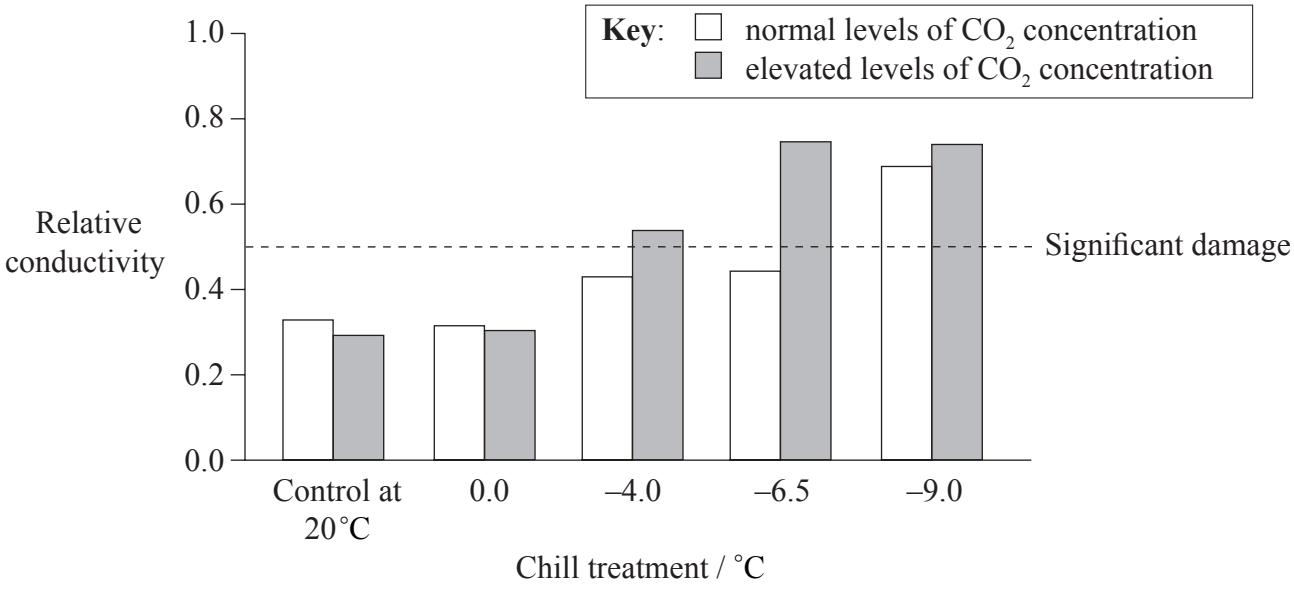
(Question 1 continued)

Researchers have carried out long-term studies into the relationship between the exposure of plants to elevated levels of CO_2 concentration and their tolerance to freezing. The chart below shows the amount of membrane damage caused when plants are grown at different temperatures in normal or elevated levels of CO_2 concentration. The membrane damage was indicated by the amount of membrane leakage and this was measured in terms of relative conductivity (high conductivity indicates membrane leakage).



[Source: A C Terry *et al*, *Plant physiology 2000*, **124**, pages 183–190,
© American Society of Plant Biologists reprinted with permission.]

(e) Identify the relationship between chill treatment and membrane leakage at normal levels of CO_2 concentration. *[1]*

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(f) Identify the temperature at which significant membrane damage begins to occur in plants treated with elevated levels of CO_2 concentration. *[1]*

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(g) Evaluate the effect of elevated levels of CO_2 concentration on the freezing tolerance of plants. *[1]*

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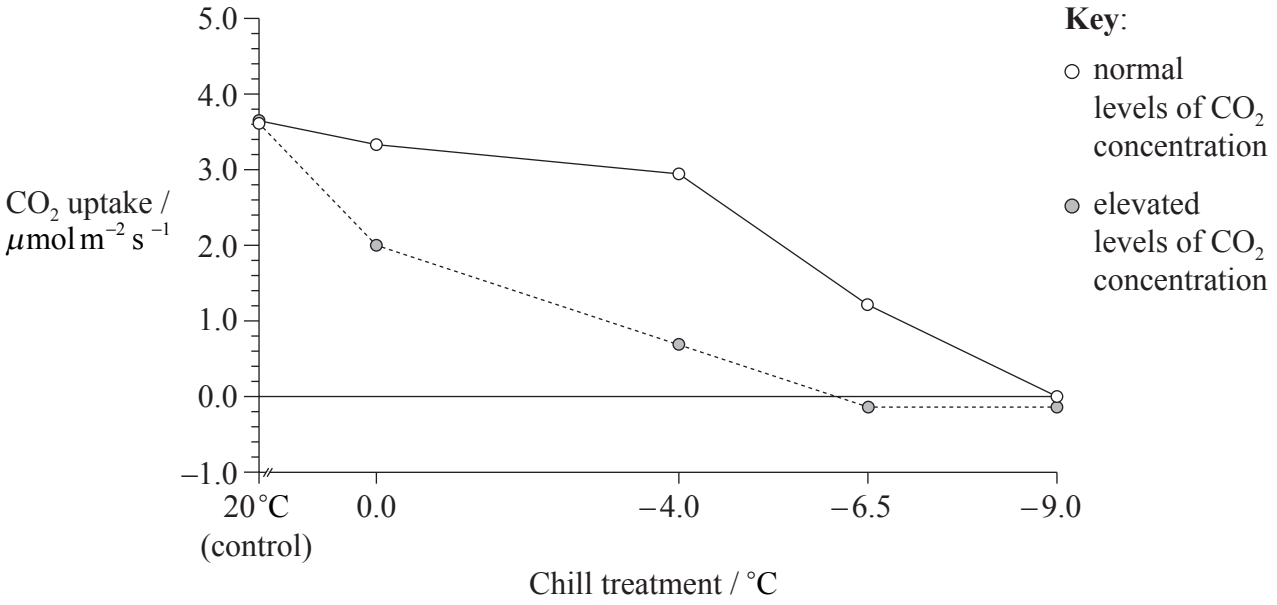
(This question continues on the following page)

(Question 1 continued)

Researchers wanted to evaluate the effect of chilling treatment on the rate of photosynthesis, measured by CO_2 uptake. This was carried out at normal levels and elevated levels of CO_2 concentration. The photosynthetic rate was measured three weeks after chilling treatment began.



[Source: A C Terry *et al*, *Plant physiology 2000*, **124**, pages 183–190]

(h) Calculate the change in CO_2 uptake from 0.0°C to –4.0°C in plants grown in elevated levels of CO_2 concentration. *[1]*

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(i) Outline the effect of chilling treatment on rate of photosynthesis of plants grown at different levels of CO_2 concentration. *[2]*

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(j) Suggest what factor other than membrane damage causes a drop in the rate of photosynthesis as the temperature decreases. *[1]*

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(This question continues on the following page)

(Question 1 continued)

(k) Analyse the long-term consequences of the greenhouse effect on the freezing tolerance and chilling tolerance of plants. *[2]*

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2. (a) Define the term *pathogen*. *[1]*

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(b) State the difference between *active immunity* and *passive immunity.* *[2]*

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(c) Explain the process of antibody production. *[3]*

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3. Students investigated a community of trees by sampling a total area of 20 000 m^2.

Species	Number of plants
Douglas fir (*Pseudostuga menziesii)*	30
Big Leaf Maple *(Acer macrophyllum)*	60
Grand Fir (*Abies grandis)*	240

[Source: Unpublished data from April 2003, Western Oregon University]

(a) Calculate the plant density for the Grand Fir. *[1]*

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(b) Describe the method used to collect this data. *[3]*

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(c) Explain why populations show a sigmoidal growth curve. *[3]*

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4. (a) Determine the mRNA sequence that is coded by the following strand of DNA. *[1]*

Sense:	A	T	G	C	T	A	G	A	C
	T	A	C	G	A	T	C	T	G

mRNA: . . . . . .

(b) Outline how the lac operon controls gene expression. *[2]*

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(c) Outline the structure of nucleosomes. *[1]*

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SECTION B

*Answer **two** questions. Up to two additional marks are available for the construction of your answers. 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) Define the term *homeostasis* and list **four** variables under homeostatic control in humans (excluding water balance). *[5]*

(b) Draw and label a diagram of the structure of the human kidney. *[4]*

(c) Explain the role of the nephron in maintaining the water balance of the blood in the human body. *[9]*

6. (a) Outline the **four** phases of mitosis. *[4]*

(b) Explain the relationship of Mendel's law of segregation and independent assortment with meiosis. *[8]*

(c) Using a table, compare spermatogenesis with oogenesis. *[6]*

7. (a) Outline the structure of part of a double stranded DNA molecule, using a simplified diagram. *[5]*

(b) Discuss the advantages **and** disadvantages of genetic screening. *[9]*

(c) Outline the technique that would be used to transfer a human gene to *E. coli*, starting with mature mRNA. *[4]*

8. (a) Outline factors that result in a high transpiration rate in a mesophytic plant. *[5]*

(b) List **four** adaptations of xerophytic plants. *[4]*

(c) Define the term *evolution* and, using **two** examples, explain the process of evolution in response to environmental change. *[9]*