N10/4/BIOLO/HP2/ENG/TZ0/XX

88106002

International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

BIOLOGY
HIGHER LEVEL
PAPER 2

Tuesday 2 November 2010 (afternoon)

2 hours 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 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.

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10 pages

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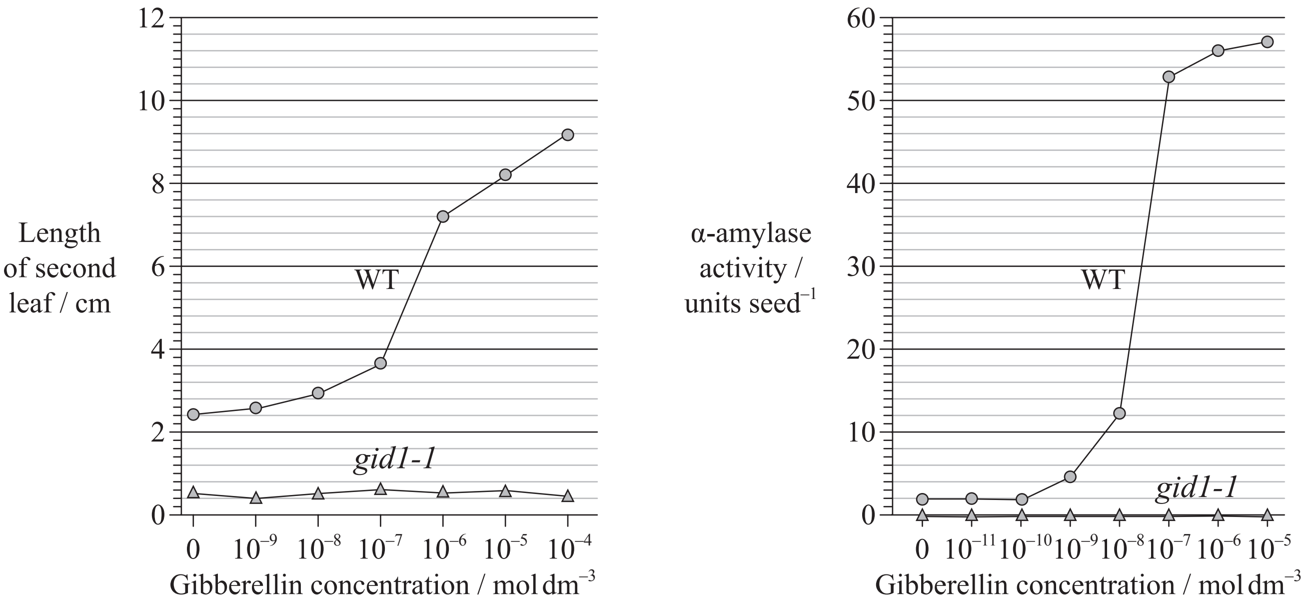
SECTION A

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

1. Gibberellin promotes both seed germination and plant growth. Researchers hypothesize that the gene *GID1* in rice (*Oryza sativa*) codes for the production of a cell receptor for gibberellin. The mutant variety *gid1-1* for that gene leads to rice plants with a severe dwarf phenotype and infertile flowers when homozygous recessive. It is suspected that homozygous recessive *gid1-1* plants fail to degrade the protein SLR1 which, when present, inhibits the action of gibberellin. The graphs show the action of gibberellin on the leaves and α-amylase activity of wild-type rice plants (WT) and their *gid1-1* mutants.



[Source: adapted from M. Ueguchi-Tanaka et al. (2005) 'Gibberellin-insensitive dwarf1 encodes a soluble receptor for gibberellin'. Nature, 437, pp. 693—698. Adapted by permission from Macmillan Publishers Ltd (c) 2005.]

(a) (i) State which variety of rice fails to respond to gibberellin treatment. *[1]*

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(ii) The activity of α-amylase was tested at successive concentrations of gibberellin. Determine the increment in gibberellin concentration that produces the greatest change in α-amylase activity in wild-type rice plants (WT). *[1]*

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(iii) Outline the role of α-amylase during the germination of seeds. *[1]*

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(This question continues on the following page)

(Question 1 continued)

(b) Discuss the consequence of crossing *gid1-1* heterozygous rice plants amongst themselves for food production. *[3]*

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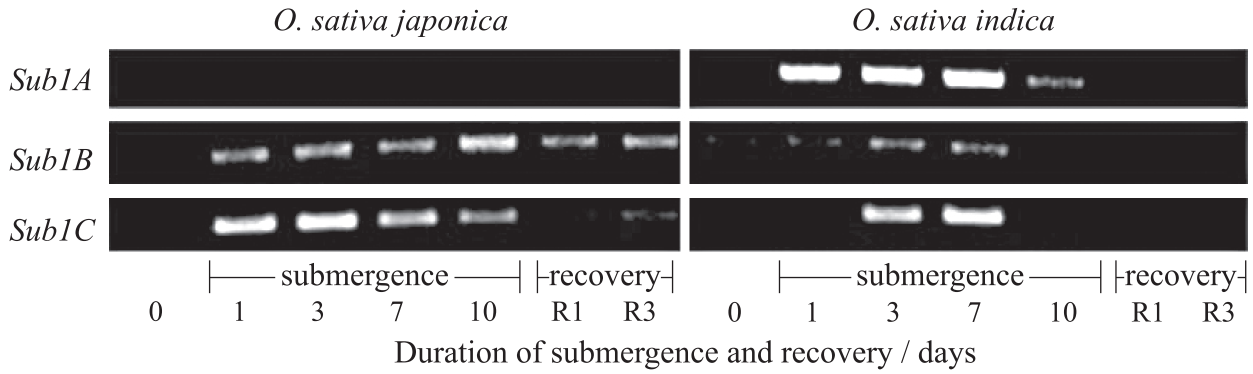
(Question 1 continued)

Most rice varieties are intolerant to sustained submergence under water and will usually die within a week. Researchers have hypothesized that the capacity to survive when submerged is related to the presence of three genes very close to each other on rice chromosome number 9; these genes were named *Sub1A*, *Sub1B* and *Sub1C*. The photograph below of part of a gel shows relative amounts of messenger RNA produced from these three genes by the submergence-intolerant variety, *O. sativa japonica*, and by the submergence-tolerant variety, *O. sativa indica*, at different times of a submergence period, followed by a recovery period out of water.



[Source: Adapted from "Sub1A is an ethylene-response-factor-like gene that confers submergence tolerance to rice" (2006) Kenong Xu, Xia Xu, Takeshi Fukao, Patrick Canlas, Reycel Maghirang-Rodriguez et al. Nature, 442, pp. 705—708. Adapted by permission from Macmillan Publishers Ltd (c) 2006.]

(c) (i) Determine which gene produced the most mRNA on the first day of the submergence period for variety *O. sativa japonica*. *[1]*

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(ii) Outline the difference in mRNA production for the three genes during the submergence period for variety *O. sativa indica*. *[2]*

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(d) Using only this data, deduce which gene confers submersion resistance to rice plants. *[2]*

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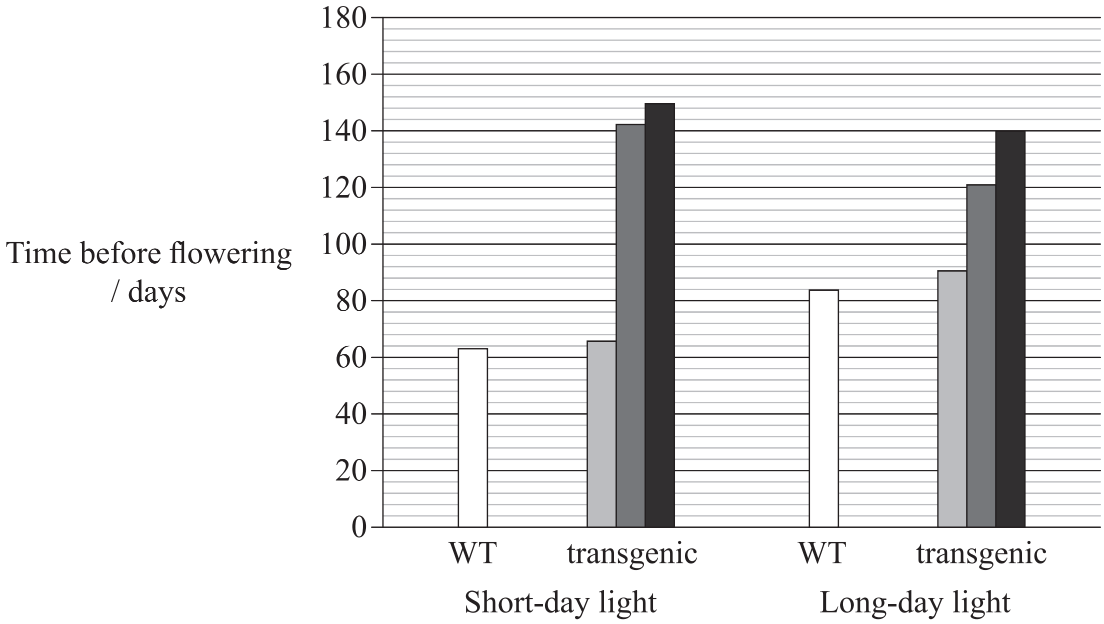
(Question 1 continued)

The *OsGI* gene causes long-day flowering and the effect of its overexpression has been observed in a transgenic variety of rice. Some wild-type rice (WT) and transgenic plants were exposed to long days (14 hours of light per day) and others to short days (9 hours of light per day).

The shades of grey represent the genotypes of the transgenic plants, where:

- –/– do not have the overexpressed *OsGI* gene
- +/– are heterozygous for the overexpressed *OsGI* gene
- +/+ are homozygous for the overexpressed *OsGI* gene.



[Source: adapted from R. Hayama, S. Yokoi, S. Tamaki, M. Yano and K. Shimamoto (2003) 'Adaptation of photoperiodic control pathways produces short-day flowering in rice.' Nature, 422, pp. 719—722. Adapted by permission from Macmillan Publishers Ltd (c) 2003.]

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(Question 1 continued)

(e) (i) State the overall effect of overexpression of the *OsGI* gene in plants treated with short-day light. *[1]*

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(ii) Compare the results between the plants treated with short-day light and the plants treated with long-day light. *[2]*

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(iii) State, giving **one** reason taken from the data opposite, if unmodified rice is a short-day plant **or** a long-day plant. *[1]*

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(f) Discuss, using only the data opposite, if $OsGI^{+}$ and $OsGI^{-}$ behave as codominant alleles. *[2]*

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(g) Evaluate, using all the data, how modified varieties of rice could be used to overcome food shortages in some countries. *[2]*

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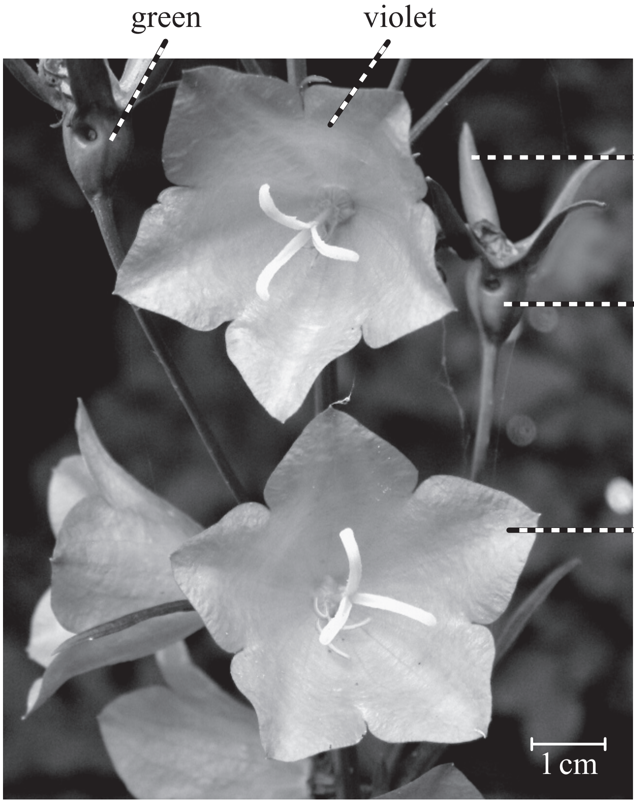
2. (a) The photograph below shows the flowers of *Campanula persicifolia*. Label structures I, II and III. *[3]*



I. ....

II. ....

III. ....

[Source: photograph provided by IB examiner]

(b) (i) Using the external features shown in the photograph, state the phylum to which this plant belongs. *[1]*

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(ii) Comment on the hypothesis that the plant shown in the photograph could be pollinated by an animal. *[2]*

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(c) Outline the use of the binomial system of nomenclature in *Campanula persicifolia*. *[2]*

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3. (a) Define the term *passive immunity*. *[1]*

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(b) State **one** use of monoclonal antibodies in diagnosis. *[1]*

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(c) Define the term *pathogen*. *[1]*

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(d) Outline why antibiotics are effective against bacteria but not against viruses. *[2]*

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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.*

4. (a) State **four** functions of proteins, giving a **named** example of each. *[4]*

(b) Outline the structure of ribosomes. *[6]*

(c) Explain the process of transcription leading to the formation of mRNA. *[8]*

5. (a) Draw a labelled diagram of a mature sperm cell. *[4]*

(b) Outline the role of hormones in the menstrual cycle. *[6]*

(c) Discuss the cause, transmission and social implications of AIDS. *[8]*

6. (a) Draw a labelled graph showing a sigmoid (S-shaped) population growth curve. *[4]*

(b) Describe what is meant by a food chain and a food web. *[6]*

(c) Explain the relationship between rises in concentration of atmospheric gases and the enhanced greenhouse effect. *[8]*

7. (a) Draw a labelled diagram of the ultrastructure of *Escherichia coli* as an example of a prokaryote. *[4]*

(b) Describe the events that occur in the four phases of mitosis in animals. *[6]*

(c) Explain the process of aerobic cell respiration after glycolysis has occurred. *[8]*