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**BIOLOGY**
**STANDARD LEVEL**
**PAPER 2**

Tuesday 2 November 2010 (afternoon)

1 hour 15 minutes

Candidate session number

| 0 | 0 | | | | | | | |
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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.



0108

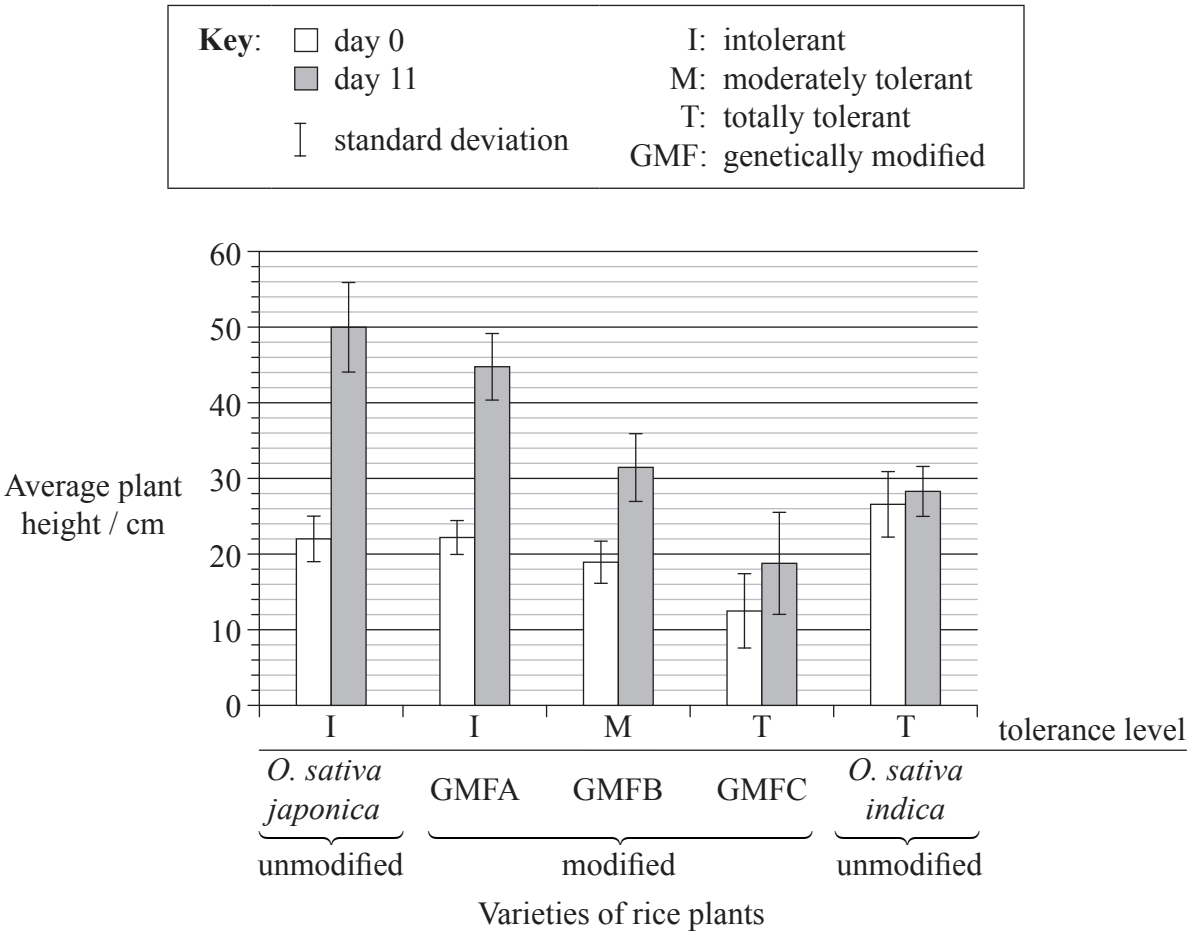
## SECTION A

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

**1.** Rice (*Oryza sativa*) is usually intolerant to sustained submergence under water, although it grows rapidly in height for a few days before dying. This is true for one variety, *Oryza sativa japonica*. The variety *Oryza sativa indica* is much more tolerant to submergence.

Three genetically modified forms of *O. sativa japonica*, GMFA, GMFB and GMFC, were made using different fragments of DNA taken from *O. sativa indica*.

The plants were then submerged for a period of 11 days. The heights of all the plants were measured at the beginning and at the end of the submergence period.




[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.]

*(This question continues on the following page)*

*(Question 1 continued)*

(a) (i) State which group of rice plants were the shortest at the beginning of the experiment. *[1]*

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(ii) Calculate the percentage change in height for the *O. sativa japonica* unmodified variety during the submergence period. Show your working. *[2]*

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(b) Explain how the error bars can be used to compare the results for *O. sativa indica*. *[2]*

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(c) Deduce the general relationship between the growth of all the *japonica* varieties and their stated tolerance level. *[1]*

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(d) Outline the use of the binomial system of nomenclature in *Oryza sativa*. *[2]*

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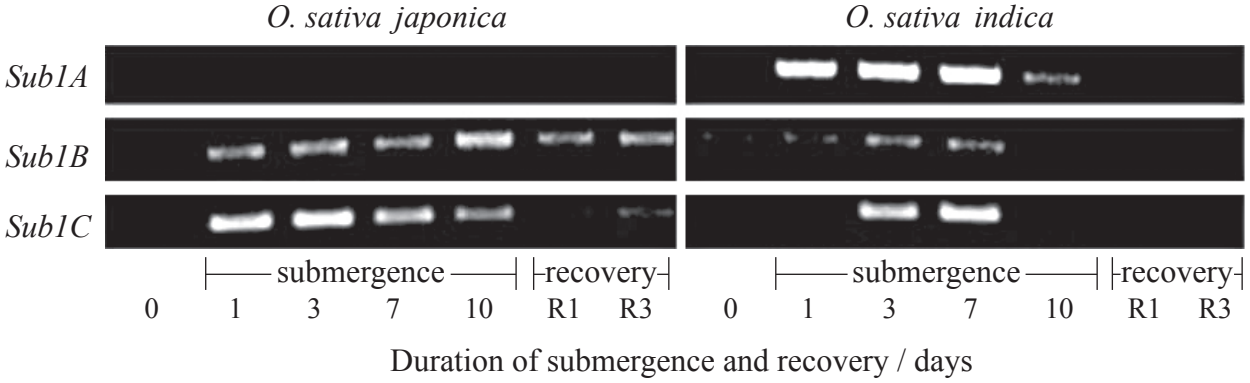
*(This question continues on the following page)*

*(Question 1 continued)*

In the same experiment, the researchers 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.]

(e) (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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(iii) Compare the mRNA production for the three genes during the submergence period between the two varieties. *[2]*

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*(This question continues on the following page)*

*(Question 1 continued)*

(f) Deduce, using all the data, which gene was used to modify GMFC. *[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.** The following sequence of pictures, made using an electronic imaging technique, shows a cell undergoing division.

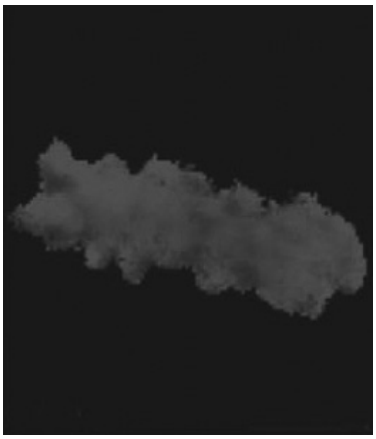

Image I

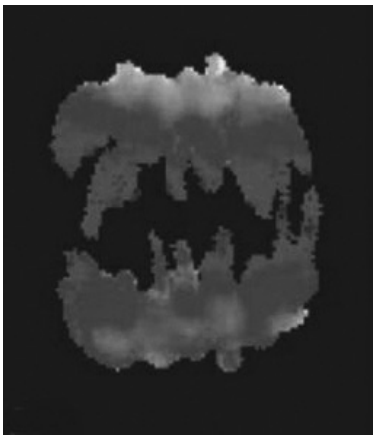

Image II

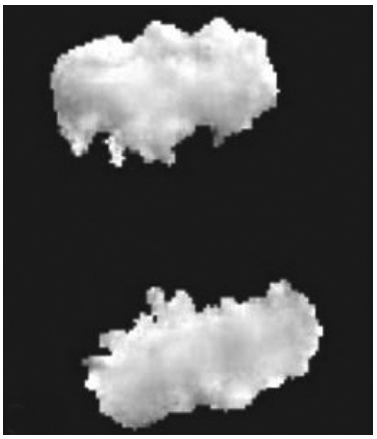

Image III

[Midzone activation of aurora B in anaphase produces an intracellular phosphorylation gradient, Brian G. Fuller, Michael A. Lampson, Emily A. Foley, Sara Rosasco-Nitcher, Kim V. Le et al. Nature, vol 453, issue 7198, 2008 Nature Publishing Group. Reproduced with permission.]

(a) State the stage of mitosis typified by image II. *[1]*

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(b) List **two** processes that involve mitosis. *[2]*

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(c) State the process that results in tumour (cancer) formation or development. *[1]*

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(d) Explain, using **one** example, how non-disjunction in meiosis can lead to changes in chromosome number. *[2]*

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**3.** (a) List **two** functions of membrane proteins. *[2]*

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(b) Explain why digestion of large food molecules is essential. *[1]*

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

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(d) Outline the use of polymerase chain reaction (PCR) to copy and amplify minute quantities of DNA. *[2]*

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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.*

**4.** (a) State **four** elements that are needed by living organisms, other than carbon, hydrogen and oxygen, giving **one** role of each. *[4]*

(b) Outline how light energy is used and how organic molecules are made in photosynthesis. *[6]*

(c) Explain the significance of complementary base pairing for replication, transcription and translation. *[8]*

**5.** (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]*

**6.** (a) State **four** molecules transported by the blood. *[4]*

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

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