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BIOLOGY
HIGHER LEVEL
PAPER 2

Candidate session number

0	0								

Monday 13 May 2013 (afternoon)

2 hours 15 minutes

Examination code

2	2	1	3	–	6	0	0	8

INSTRUCTIONS TO CANDIDATES

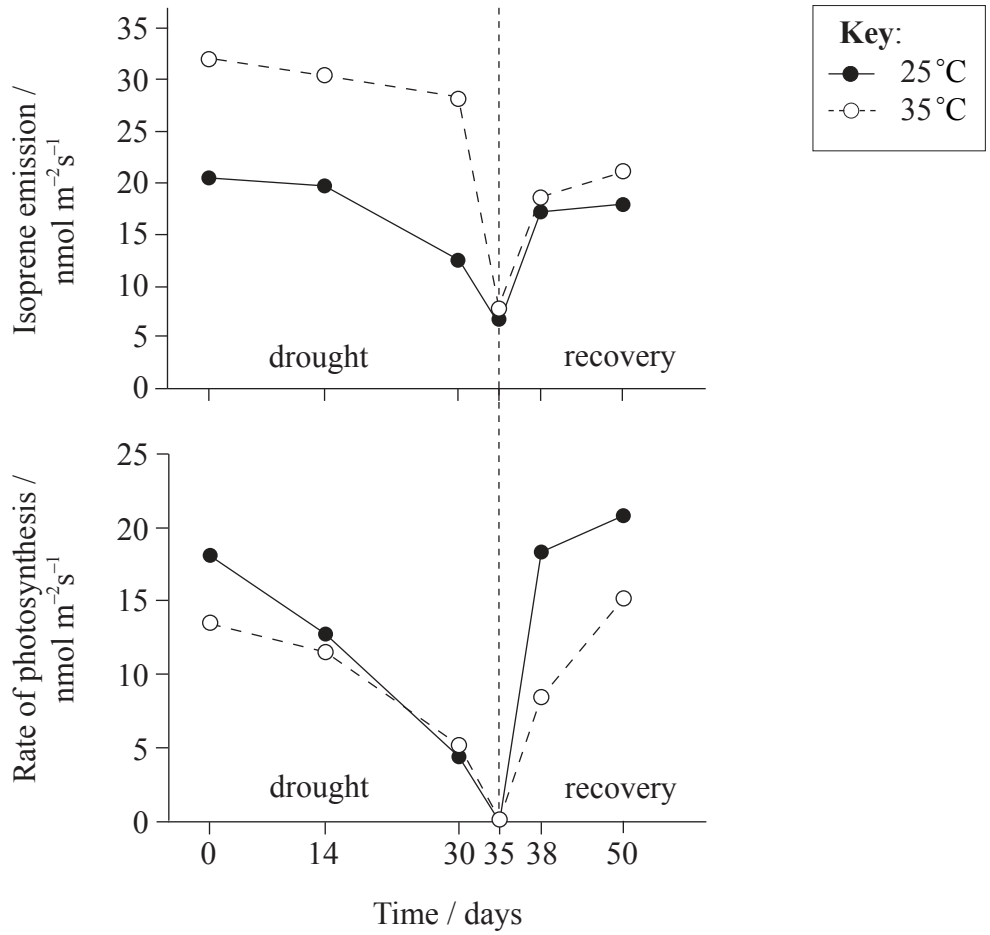
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer two questions.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is *[72 marks]*.

SECTION A

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

1. Isoprene is a chemical synthesized and emitted in large amounts by some plant species, especially oak (*Quercus* sp.) and poplar (*Populus* sp.) trees. It has been suggested that isoprene increases the tolerance of plants to high temperatures, which can cause a decrease in photosynthesis rates.

Black poplar (*Populus nigra*) plants were subjected to two raised temperatures and to drought. Measurements of photosynthesis and isoprene emission were made during a 35-day-long drought stress (drought period) and 3 and 15 days after re-watering stressed plants (recovery period). The rate of photosynthesis was recorded as the carbon dioxide taken up per unit of leaf area per second.



[Source: A. Fortunati et al. (2008) "Isoprene emission is not temperature-dependent during and after severe drought-stress: a physiological and biochemical analysis", *The Plant Journal*, 55, pages 687–697]

(This question continues on the following page)

(Question 1 continued)

(a) Suggest **one** method other than measuring CO_2 uptake by which the rate of photosynthesis could have been measured in these experiments. *[1]*

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(b) Suggest why heat treatment may reduce photosynthesis rates. *[2]*

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(c) Outline the effect of drought and of re-watering on the rate of photosynthesis. *[1]*

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(d) Describe the isoprene emissions during the drought and recovery periods at 25 °C. *[2]*

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(Question 1 continued)

(e) Compare the effect of the two temperatures on the emission of isoprene. *[2]*

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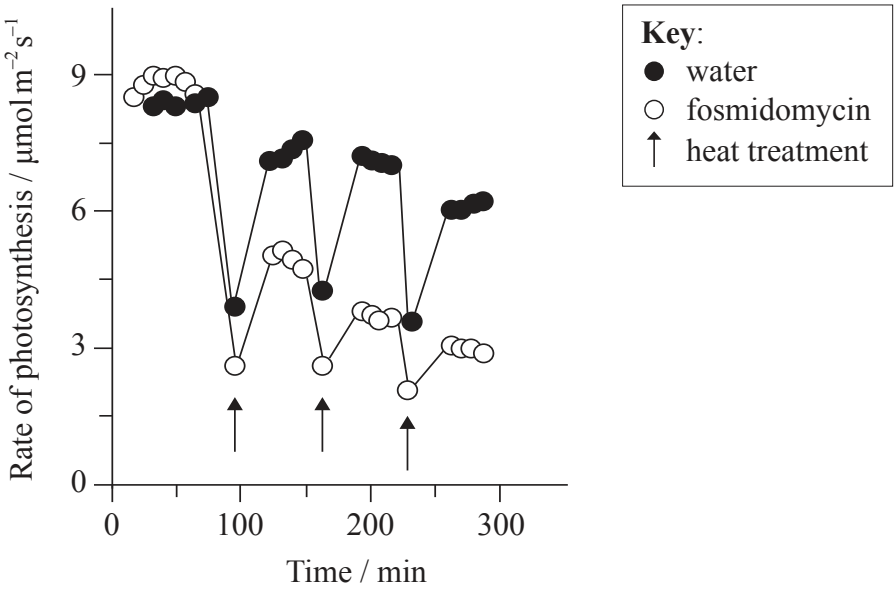
will not be marked.

(Question 1 continued from page 4)

The effect of isoprene on photosynthesis was assessed in detached oak leaves that were supplied either water (control) or fosmidomycin dissolved in water. Fosmidomycin inhibits the emission of isoprene without affecting photosynthesis. The measurements were taken at 30 °C, but at three points in the experiment the leaves were subjected to heat treatment of 46 °C (indicated on the graph by the arrows). The rate of photosynthesis was measured as uptake of CO_2 in $\mu mol\, m^{-2} s^{-1}$.



[Source: Sharkey, T.D., X.Y. Chen, and S. Yeh. Isoprene increases thermotolerance of fosmidomycin-fed leaves. *Plant Physiology*, April 2001, vol. 125, no. 4, 2001–2006. www.plantphysiol.org © American Society of Plant Biologists.]

(f) State the effect of heat treatment on the rate of photosynthesis. *[1]*

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(This question continues on the following page)

(Question 1 continued)

(g) Using the results in the graph, deduce the effect of the presence of fosmidomycin on the rate of photosynthesis in the leaves. *[2]*

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(h) Suggest possible conclusions for this experiment. *[2]*

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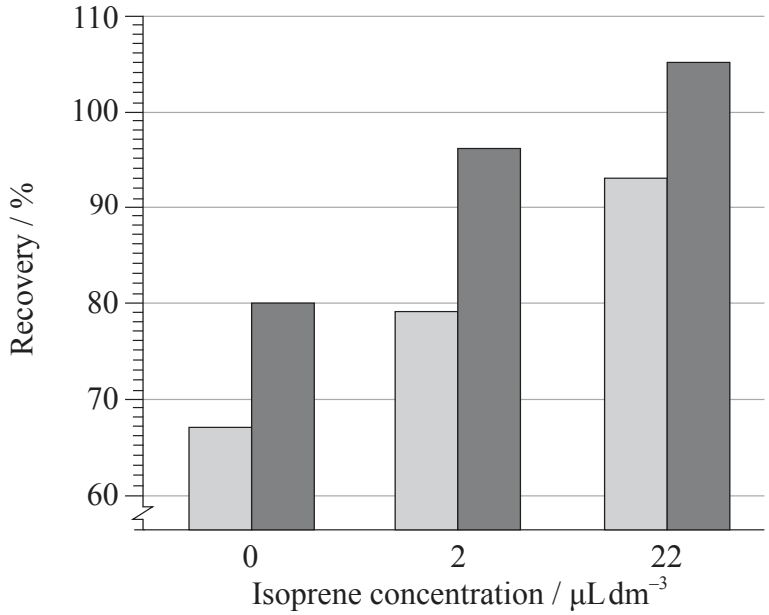
(Question 1 continued)

To test the effect of isoprene on a plant that does not normally produce it, leaves of common beans (*Phaseolus vulgaris*) were treated with heat stress at 46 °C and were supplied with isoprene in the airstream. The percentage recovery compares the rate of photosynthesis before and after heat treatment. The data show the recovery of photosynthesis at different isoprene concentrations 1 hour and 24 hours after the heat treatment.



[Source: Sharkey, T.D., X.Y. Chen, and S. Yeh. Isoprene increases thermotolerance of fosmidomycin-fed leaves. *Plant Physiology* April 2001, vol. 125, no. 4, 2001–2006. www.plantphysiol.org © American Society of Plant Biologists.]

(i) State the difference in percentage recovery of photosynthesis 1 hour after heat treatment between the 22 $\mu L\,dm^{-3}$ isoprene treatment and the 0 $\mu L\,dm^{-3}$ isoprene treatment. *[1]*

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(Question 1 continued)

(j) Explain the evidence provided by the data in the bar chart for the hypothesis that isoprene improves plants' tolerance to high temperatures. *[2]*

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(k) Suggest **two** reasons for some plant species synthesizing and emitting isoprene, but not other plant species such as common beans. *[2]*

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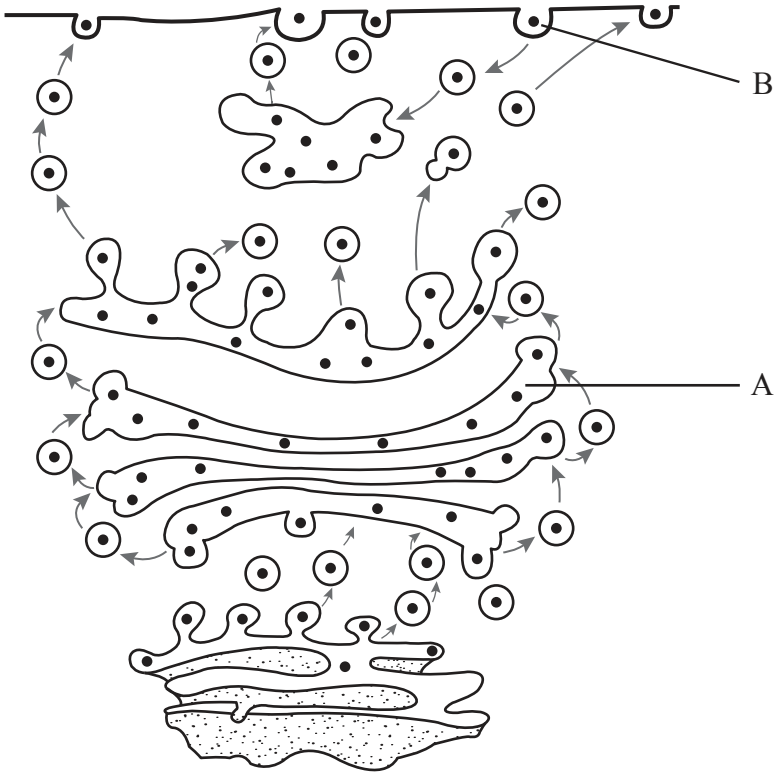
2. The diagram shows how vesicles are used to transport materials in a cell.



(a) (i) State the name of organelle A. *[1]*

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(ii) State the process occurring at B. *[1]*

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(Question 2 continued)

(b) Describe how the structure of the membrane allows the formation of vesicles. *[2]*

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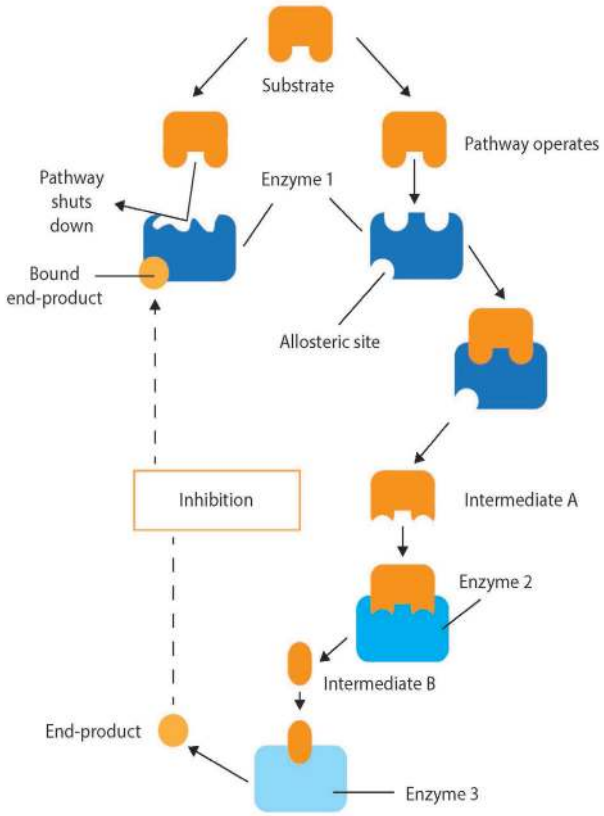
3. The following diagram shows the synthesis and regulation of some amino acids.



[Source: © International Baccalaureate Organization 2013]

(a) State the type of inhibition shown in this diagram. *[1]*

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(b) Explain how this type of regulation could affect the synthesis of an amino acid. *[2]*

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(Question 3 continued)

(c) Outline the models that describe how substrates bind to enzymes. *[2]*

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4. (a) Distinguish between autotrophs and heterotrophs. *[2]*

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(b) Define *saprotroph*. *[1]*

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(Question 4 continued)

(c) State an external feature that is different in:

(i) Cnidaria and Mollusca. *[1]*

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(ii) Mollusca and Annelida. *[1]*

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will not be marked.

SECTION B

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

5. (a) Draw a labelled plan diagram to show the distribution of tissues in the leaf of a dicotyledonous plant. *[4]*

(b) Outline the metabolic processes that occur in starchy seeds during germination. *[6]*

(c) Explain the light-independent processes of photosynthesis in plants. *[8]*

6. (a) Describe the process of blood clotting. *[4]*

(b) Factor IX is a blood clotting protein which some hemophiliacs lack. In the future hemophilia could be treated using clotting factors synthesized by genetically modified bacteria. Outline the basic technique used for this gene transfer. *[6]*

(c) Explain how males inherit hemophilia and how females can become carriers for the condition. *[8]*

7. (a) Outline the types of evidence that can be used to support the theory of evolution. *[4]*

(b) Outline the relationship between Mendel's law of independent assortment and meiosis. *[6]*

(c) Explain **two** examples of evolution in response to an environmental change. *[8]*

8. (a) Draw a labelled diagram of a mitochondrion as seen in an electron micrograph. *[4]*

(b) A supply of oxygen is needed for aerobic respiration in mitochondria. Describe the features of alveoli in human lungs that adapt them for efficient absorption of oxygen. *[6]*

(c) Explain the mechanism of ventilation of human lungs. *[8]*