22136011

International Baccalaureate
Baccalauréat International
Bachillerato Internacional

BIOLOGY
STANDARD LEVEL
PAPER 2

Candidate session number

0	0								

Monday 13 May 2013 (afternoon)

1 hour 15 minutes

Examination code

2	2	1	3	–	6	0	1	1

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 one question.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is *[50 marks]*.

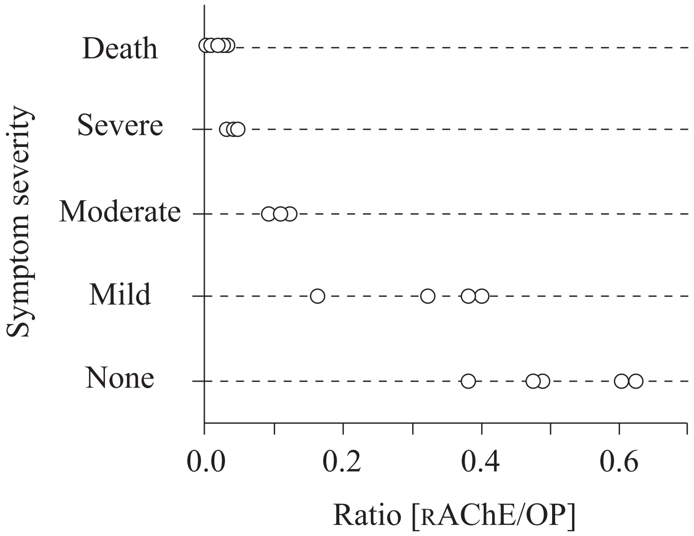
16 pages

SECTION A

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

1. Exposure to organophosphorus pesticides (OP) is a cause of serious nerve damage. It disrupts synaptic transmission by inhibiting the enzyme acetylcholinesterase, causing death due to cardiovascular and respiratory failure.

Recombinant human acetylcholinesterase (rAChE) was obtained by genetic engineering and produced in *Nicotiana benthamiana* plants. It was tested as a new therapeutic treatment in mice that were exposed to OP. The following graph shows the severity of the symptoms shown by each mouse at different ratios of rAChE to OP.



[Source: T. Evron *et al.* (2007), "Plant-derived human acetylcholinesterase-R provides protection from lethal organophosphate poisoning and its chronic aftermath", *FASEB Journal*, 21 (11), pages 2961–2969: Figure 4a. Reprinted with permission.]

(a) State the minimum ratio at which some mice showed no symptoms. *[1]*

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(Question 1 continued)

(b) Analyse the effect of increasing the ratio of rAChE to OP on the symptoms in mice. *[3]*

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(c) Predict what would happen if a mouse received 300 mg of rAChE and 600 mg of OP. *[2]*

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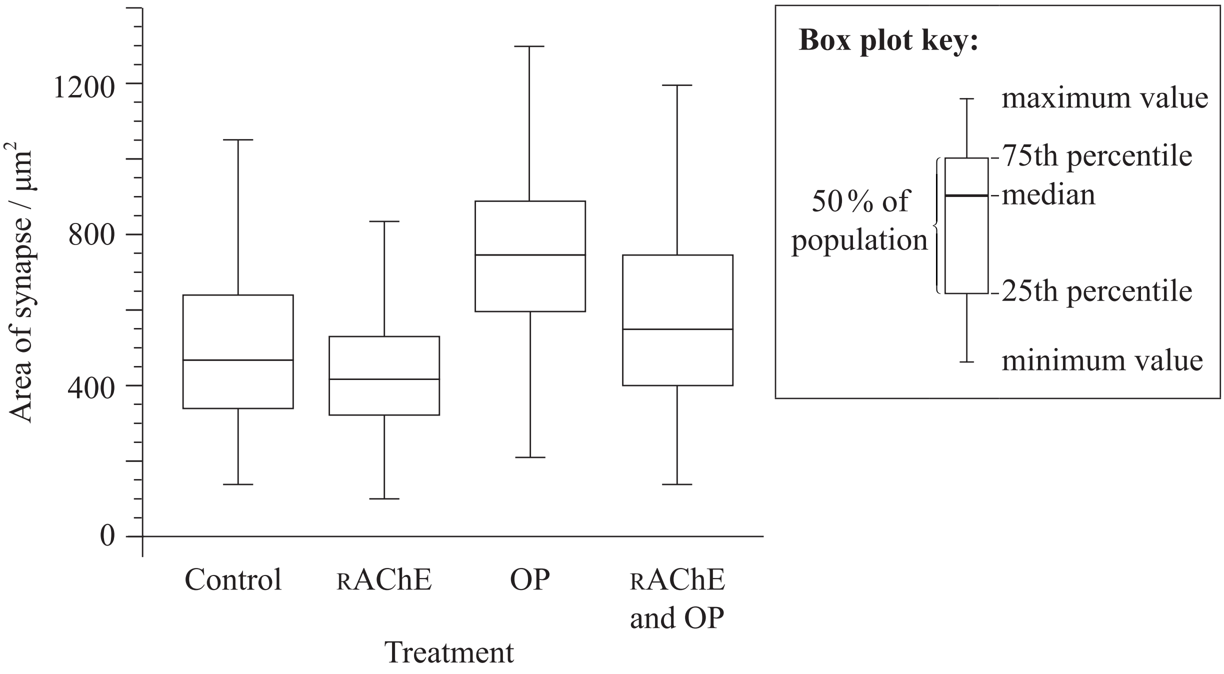
(Question 1 continued)

To test the effect of OP damage on synapses, mice were treated with rAChE, OP or both. Their diaphragms were dissected 10 days after treatment. The area of the synapse between axons and the diaphragm was measured. When the synapses are damaged by OP there is a greater area. The box plot shows the effect of different treatments on the area of the synapse.



[Source: Tama Evron, Brian C. Geyer, Irene Cherni, Mrinalini Muralidharan, Jacquelyn Kilbourne, Samuel P. Fletcher, Hermona Soreq and Tsafrir S. Mor (2007), "Plant-derived human acetylcholinesterase-R provides protection from lethal organophosphate poisoning and its chronic aftermath", *FASEB Journal*, 21 (11), pages 2961–2969: Figure 5b. Reprinted with permission.]

(d) Calculate the difference in median area of synapse between the control mice and mice treated with rAChE and OP, giving the units. *[1]*

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(Question 1 continued)

(e) Describe the evidence for damage to synapses by OP provided by data in the box plot. *[2]*

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(f) Using the data from **both** graphs, evaluate the hypothesis that plant-produced rAChE could be used to protect humans or other mammals from damage caused by exposure to OP. *[2]*

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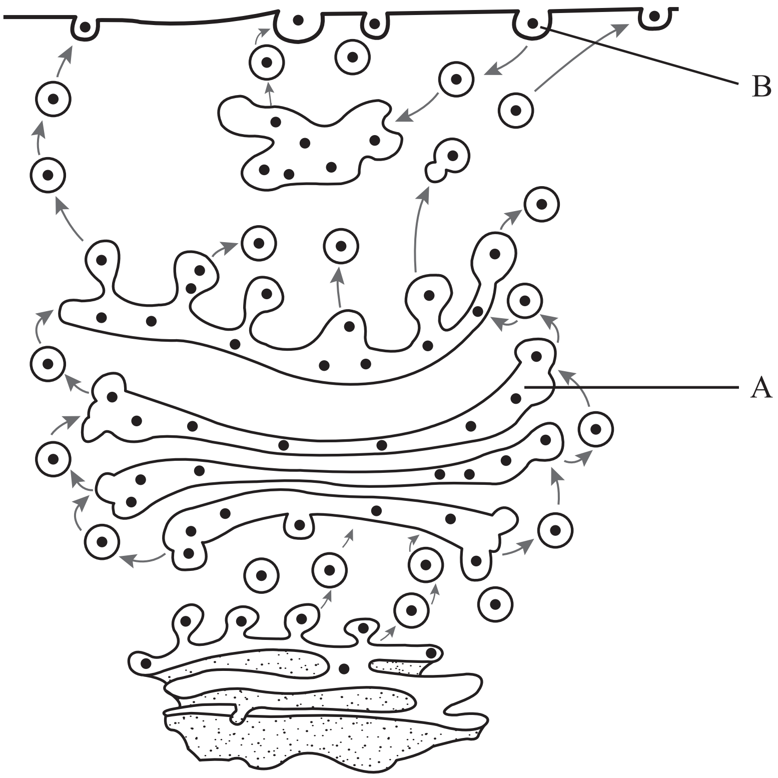
2. The diagram shows how vesicles are used to transport materials in a cell.



(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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(c) Explain active transport across membranes. *[3]*

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

(b) Outline an external feature that is different in:

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

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

4. (a) State **three** processes occurring in a cell during interphase of the cell cycle but not in mitosis. *[3]*

1. . . . .
2. . . . .
3. . . . .

(b) Draw a diagram to show the following stages of mitosis in an animal cell: *[2]*

Metaphase:

Anaphase:

(c) Explain how sexual reproduction can allow evolution to occur. *[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 in the boxes provided.*

5. (a) Describe the properties of water that make it a useful component of blood. *[4]*

(b) Explain the relationship between structure and function of arteries, capillaries and veins. *[8]*

(c) Outline how leucocytes defend the body against pathogens. *[6]*

6. (a) Outline the difference in absorption of red, blue and green light by chlorophyll. *[4]*

(b) Explain how the process of photosynthesis affects carbon dioxide concentrations in the atmosphere during a typical year **and** the likely consequences on Earth of the yearly rises in carbon dioxide concentrations. *[8]*

(c) Outline the precautionary principle. *[6]*

7. (a) Define *codominant allele*, *recessive allele*, *locus* and *sex linkage*. *[4]*

(b) ABO blood groups are inherited from parents, but it is possible for a child to have a different blood group from either parent. Outline how this can happen using a Punnett grid. *[6]*

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