2014 Senior External Examination

Biology
Paper Two — Question and response book

Time allowed
- Perusal time: 10 minutes
- Working time: 2 hours

Examination materials provided
- Paper Two — Question and response book
- Notepaper

Equipment/materials allowed
- QCAA-approved equipment
- non-programmable calculator
- one A4 sheet of EBI question topic research notes

Directions
Do not write in this book during perusal time.
Paper Two has two parts:
- Part A — Continuity of life
- Part B — Evolution and diversity
Attempt all questions.

Suggested time allocation
- Part A: 60 minutes
- Part B: 60 minutes

Assessment
Paper Two assesses the following assessment criteria:
- Understanding biology (UB)
- Investigating biology (IB)
- Evaluating biological issues (EBI)
Assessment standards are at the end of this book.

After the examination session
The supervisor will collect this book and your research notes when you leave.
Planning space
Part A — Continuity of life

Questions 1–7 assess Understanding biology (UB) and Investigating biology (IB).

Attempt all questions. Write your responses in the spaces provided.

Suggested time allocation: **60 minutes**.

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**Question 1 (UB)**

There are two types of cell division. Name these types, give an example of where each occurs and explain their significance.

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**Question 2 (UB)**

The following karyotype is from a frog. Sex determination in frogs operates on the same principle as in humans.

![Karyotype](image)

a. Is this karyotype prepared from a haploid or diploid cell nucleus? Give a reason for your choice.

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b. What is the sex of the individual? Give a reason for your choice.

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c. How are chromosomes A and B different in their origin?
**Question 3 (UB)**

a. Complete the following table.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>DNA</th>
<th>RNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of sugar molecule</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usual location in cell</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen bases present in molecule</td>
<td></td>
<td></td>
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<tr>
<td>Usual number of strands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Functions in the cell</td>
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</tbody>
</table>

b. Suppose a gene contains the code for the synthesis of an enzyme. During replication of the gene a mutation occurs so that one of the nucleotides is left out. Is it more likely that the enzyme produced will be close to ‘normal’ if the deleted base occurs near the beginning or end of the gene? Justify your response.

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**Question 4 (UB)**

Read the following text and then respond to the questions below.

Gregor Mendel experimented with pea plants. In one experiment he studied how the height of the pea plant was inherited. He took pure-breeding tall plants and crossed them with pure-breeding dwarf plants. He collected the pea seeds produced, and grew them to give an F1 generation. All F1 plants were tall. These F1 tall plants were allowed to self-fertilise. He collected the seeds and grew them to produce the F2 generation. Three-quarters of the F2 plants were tall; one-quarter were dwarf.

a. If pure-breeding tall plants were self-fertilised, what kind of plants will always grow from the seeds that are produced?

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b. Which characteristic is dominant (tall or dwarf)? Explain your response.


c. Complete this diagram to represent the alleles in the gametes and the F₁ plants.

![Diagram of parents, gametes, and F₁ plants]

Fertilisation

F₁ plants: All

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d. The diagram below shows the cross between the F₁ plants. Complete the diagram by writing in the boxes the alleles of the parents and the F₂ plants.

![Diagram of parents, gametes, and F₂ generation]

Parents: F₁

Gametes ½ ½ ½ ½

Fertilisation

F₂ generation ¼ ¼ ¼ ¼

Tall Tall Tall Dwarf
**Question 5 (UB)**

Tay Sachs disease is a recessive hereditary abnormality causing death within the first few years of life only when homozygous (tt). The dominant condition produces normal phenotype.

Another condition, brachyphalangy (abnormally shortened fingers) is thought to be the expression of a heterozygous genotype containing the lethal gene b, the homozygote (BB) being normal, and the other homozygote (bb) being lethal.

**a.** Draw genetic cross-diagrams to illustrate the genotypes possible from parents who both have brachyphalangy and are heterozygous for Tay Sachs disease.

**b.** What are the phenotypes and ratios expected among teenage children of these parents?
Question 6 (UB)

The diagram below shows part of Queen Victoria’s family tree (not all of her children are shown). It shows how the disease haemophilia occurred in some of her descendants. Haemophilia was not observed in any of the ancestors of Queen Victoria nor her husband Prince Albert.

The gene causing haemophilia is carried by the X chromosome.

a. From which parent did Prince Leopold (generation II – son of Queen Victoria) inherit the haemophilia gene? Explain your response.

b. Use the symbols X, X^h and Y to explain how haemophilia was passed from Leopold (generation II) to his grandson in generation IV.
Question 7 (UB/IB)

In *Drosophila melanogaster*, the vinegar fly, the curly-winged phenotype is dominant to the straight-wing phenotype.

Curly-wing males mate with straight-wing females which then lay eggs. The eggs are randomly allocated to identical nutrient tubes which are then incubated at 25 °C or 18 °C. The phenotypes of the resultant offspring are recorded and shown below.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Curly-wing fly</th>
<th>Straight-wing fly</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 °C</td>
<td>109</td>
<td>115</td>
</tr>
<tr>
<td>18 °C</td>
<td>65</td>
<td>135</td>
</tr>
</tbody>
</table>

a. Are the curly-wing parents homozygous or heterozygous? Explain your response.

b. Formulate and justify a genetic-based hypothesis to explain the results at 25 °C.

c. Suggest a reason for the difference between the results at 25 °C and 18 °C.

d. Curly-wing flies are crossed together. In the offspring, 152 flies have curly wings and 73 flies have straight wings when development occurs at 25 °C. Explain this result.

End of Part A
Part B — Evolution and diversity

Questions 1–4 assess Understanding biology (UB) and Investigating biology (IB).
Question 5 assesses Evaluating biological issues (EBI).
Attempt all questions. Write your responses in the spaces provided.
Suggested time allocation: 60 minutes.

Question 1 (IB)

The diagram below shows a family tree of several individuals of the same genus *Oryctolagos* which reproduces sexually. Each different letter represents a different individual. ‘X’ means a mating had occurred (e.g. A and B have mated to produce offspring C).

Note: Individual D is shown twice.

Using the reproductive-based definition of a species, study the data to conclude how many different species are shown in the diagram. Justify your conclusion, showing which individuals belong to the same species.

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Question 2 (UB)

Discuss two types of evidence for evolution and explain how each provides support for the theory of evolution.

Question 3 (UB)

The environment of the Hawaiian Islands has been described in the following way.

They (the islands) include a much greater variety of biotic communities, particularly in rich forests, full of plants having flowers and fruits of various sizes and shapes, and supporting a great diversity of insect life. In response to these ecological opportunities, and in the absence or scarcity of other highly developed bird groups such as exist in sub-tropical and tropical forests on the continents, the honey creepers have evolved nine genera which among them include almost as great a variety of beak shapes as are found in the entire order of perching birds which includes sparrows, warblers, finches, magpies and most of the other kinds of small birds found in continental forests.

Some of these honey creepers, together with their ancestral form, are shown below.
a. Discuss the factors involved in the evolution of the nine genera of honey creepers from one original ancestral form with particular reference to:

i. competition

ii. isolation.

b. Would you expect a similar diversity to have evolved on a group of islands with a single biotic community? Explain your response.
Two paleoanthropologists used the same fossil data to each draw a model of the human evolutionary tree. The two models they produced are shown below.

**a.** How is it possible that different models have been produced for the human evolutionary tree?

**b.** State one feature of agreement between the models.

**c.** State one feature of conflict between the models.

**d.** Evidence suggests that *Homo sapiens* and *Homo neanderthalensis* were living in the same areas some 30000 years ago, and it is unlikely that they interbred. Give one reason why interbreeding might not have occurred.

**e.** Scientists have recently discovered a tiny fossil skull in Indonesia. It has been named *Homo floresiensis* (the hobbit) and dated to the time our own ancestors were colonising the world. Some scientists believe *Homo floresiensis* evolved from *Homo erectus*. Fossils of *Homo erectus* have also been discovered in Indonesia.

Add *Homo floresiensis* to either Model 1 or Model 2 above.
Question 5 assesses Evaluating biological issues (EBI). Write an extended response below. Your response MUST refer to biological principles, concepts and ideas.

**Question 5 (EBI)**

Debate exists about whether the hobbit (*Homo floresiensis*) should be considered a new human species.

- Discuss both sides of the debate.
- Decide which side of the debate you agree with.
- Justify your decision by integrating the information discussed.
Planning space
Planning space
Planning space
### Assessment standards derived from the Biology Senior External Syllabus 2006
### Paper Two

<table>
<thead>
<tr>
<th>Criterion</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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</thead>
<tbody>
<tr>
<td><strong>Understanding biology</strong></td>
<td>The candidate communicates understanding by:</td>
<td>The candidate communicates understanding by:</td>
<td>The candidate communicates understanding by:</td>
<td>The candidate communicates understanding by stating ideas and using terminology relevant to concepts and recalling interrelationships.</td>
<td>The candidate states terminology and ideas relevant to concepts.</td>
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<td>• making links between related ideas, concepts, principles and theories to reveal meaningful interrelationships</td>
<td>• explaining ideas, concepts, principles and theories and describing interrelationships between them</td>
<td>• applying knowledge and understanding to a range of complex and challenging tasks.</td>
<td>• defining and describing ideas, concepts, principles and theories, and identifying interrelationships</td>
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<tr>
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<td>• applying knowledge and understanding to a range of complex and challenging tasks.</td>
<td>• applying knowledge and understanding to a range of complex tasks.</td>
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<td>• applying knowledge and understanding to a range of tasks.</td>
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<tr>
<td><strong>Investigating biology</strong></td>
<td>The candidate communicates investigative processes by:</td>
<td>The candidate communicates investigative processes by:</td>
<td>The candidate communicates investigative processes by:</td>
<td>The candidate communicates investigative processes by using data to answer questions.</td>
<td>The candidate communicates investigative processes by transcribing data.</td>
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<td>• formulating justified researchable questions</td>
<td>• formulating researchable questions</td>
<td>• identifying researchable questions</td>
<td>• using data to draw conclusions.</td>
<td></td>
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<tr>
<td></td>
<td>• interpreting and critically analysing data with links to theoretical concepts to draw conclusions relating to the question/s.</td>
<td>• interpreting data and drawing conclusions relating to the question/s.</td>
<td>• using data to draw conclusions.</td>
<td></td>
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</tr>
<tr>
<td><strong>Evaluating biological issues</strong></td>
<td>The candidate communicates by integrating the information and data to make justified and responsible decisions.</td>
<td>The candidate communicates by integrating the information and data to make logical decisions.</td>
<td>The candidate communicates by selecting relevant information and data to make plausible decisions and predictions.</td>
<td>The candidate communicates by making unsupported decisions.</td>
<td>The candidate communicates by restating supplied information.</td>
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