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

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

Equipment/materials allowed
- QSA-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: 70 minutes
- Part B: 50 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 1–9 assess Understanding biology (UB) and Investigating biology (IB).
Question 10 assesses Evaluating biological issues (EBI).
Attempt all questions. Write your responses in the spaces provided.
Suggested time allocation: 70 minutes.

Question 1 (UB)
State one advantage and one disadvantage of asexual reproduction.

Question 2 (UB)
The diagram below shows a cell undergoing meiotic division.

a. Describe what is happening at this stage of the division.

b. What is the purpose of this type of cell division (meiosis) and why is it important?
Question 3 (UB)

a. In mice, black-coat colour (B) is dominant to white coat-colour (b). If a heterozygous black-coat mouse is crossed with a white-coat mouse, determine the probability of producing a white-coat mouse.

b. In snapdragons, red flower colour and white flower colour show incomplete dominance. The flower colour of a heterozygous plant is pink. What is the chance of producing a plant with red flowers when a pink-flowered plant is crossed with another pink-flowered plant?
Question 4 (UB)

The hair of Himalayan rabbits is white except on the extremities (i.e. ears, nose, tail and feet). The Himalayan rabbit used in the experiment illustrated was homozygous for a gene controlling the synthesis of the black pigment melanin, which affects the colour of the extremities.

The hair on the back is normally white but by shaving the skin (I) and applying an ice pack during the period in which the hair regrew (II), it was found that the new hair was black (III).

Explain the role of the environment on the production of melanin in the Himalayan rabbit.

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I

II

III

skin shaved

ice pack

2013 Biology — Paper Two — Question and response book
Question 5 (UB)

The following diagram shows the process of protein synthesis.

![Diagram of protein synthesis]

**a.** Name structures 1, 2 and 3.

- Structure 1: .................................................................
- Structure 2: .................................................................
- Structure 3: .................................................................

**b.** Explain the difference between transcription and translation.

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**c.** Label on the diagram above where transcription and translation occur.
Question 6 (UB)

A species of small mammal has a highly visible row of hair that stands upright along the back of the animal. This characteristic, referred to as ridgeback, is determined by a recessive gene and is found in a small proportion of the natural population. In an effort to increase the frequency of this characteristic, an artificial breeding program is set up in a veterinary clinic.

Three distinct matings were set up as part of the program:

i. a heterozygous normal male with a ridgeback female

ii. a heterozygous normal male with a heterozygous normal female

iii. a pure-breeding normal male with a pure-breeding ridgeback female.

Which of the above three matings is likely to increase the number of ridgebacks in the population most quickly? Explain your response in detail, showing all working.
**Question 7 (UB)**

Phenylketonuria (PKU) is inherited as an autosomal recessive trait. It is a metabolic disorder and is characterised by the inability to produce the enzyme phenylalanine hydroxylase. The gene controlling the production of the enzyme has two allelic forms:

- enzyme produced (E)
- lack of enzyme (e).

The enzyme phenylalanine hydroxylase catalyses the following reaction:

\[
\text{phenylalanine} \xrightarrow{\text{enzyme}} \text{tyrosine}
\]

When the enzyme is absent, very high levels of phenylalanine accumulate in the blood and other tissues.

Children born with PKU will be mentally and physically impaired unless they are placed on a special diet soon after birth. They are kept on this diet until they are about 10 years of age, after which time high blood levels of phenylalanine generally have no effect.

**a.** John and Betty are both able to produce the phenylalanine hydroxylase enzyme. Their son, Thomas, has PKU. Thomas was placed on a special diet shortly after birth and developed without impairment. He married Sally, who produces the enzyme and has a PKU father.

What is the chance that a child of Thomas and Sally will have PKU? Show all reasoning and working in full.

**b.** A female with PKU can be taken off the special diet at about 10 years of age. However, her children will be mentally impaired unless she goes back on the diet before and during pregnancy. This happens irrespective of the genotype of the child.

Explain this observation.
**Question 8 (UB)**

In wild dogs, dark coat is dominant over albino and short hair is dominant over long hair. If two independently assorting genes cause these phenotypes, give the genotypes of the parents in each of the crosses given below. Show working.

<table>
<thead>
<tr>
<th>Parental phenotypes</th>
<th>Number of offspring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dark, short</td>
</tr>
<tr>
<td>a. Dark, short x dark, short</td>
<td>89</td>
</tr>
<tr>
<td>b. Dark, long x dark, long</td>
<td>0</td>
</tr>
</tbody>
</table>

(Use symbols D and d for the dark and albino coat alleles and S and s for the short hair and long hair alleles.)
Outbreaks of plague locusts can be predicted by studying the effect of various physical factors on the hatching rate of their eggs.

The results of an experiment investigating one of these factors are shown below.

<table>
<thead>
<tr>
<th>No. of eggs</th>
<th>Temp. (°C)</th>
<th>Days incubated</th>
<th>Soil moisture (%)</th>
<th>No. of eggs hatched</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>25</td>
<td>10</td>
<td>95</td>
<td>5</td>
</tr>
<tr>
<td>20</td>
<td>25</td>
<td>10</td>
<td>90</td>
<td>6</td>
</tr>
<tr>
<td>35</td>
<td>25</td>
<td>10</td>
<td>80</td>
<td>19</td>
</tr>
<tr>
<td>25</td>
<td>25</td>
<td>10</td>
<td>70</td>
<td>21</td>
</tr>
<tr>
<td>20</td>
<td>25</td>
<td>10</td>
<td>60</td>
<td>19</td>
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<tr>
<td>25</td>
<td>25</td>
<td>10</td>
<td>50</td>
<td>18</td>
</tr>
<tr>
<td>43</td>
<td>25</td>
<td>10</td>
<td>40</td>
<td>22</td>
</tr>
<tr>
<td>50</td>
<td>25</td>
<td>10</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>60</td>
<td>25</td>
<td>10</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>30</td>
<td>25</td>
<td>10</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

a. Analyse the data to draw a conclusion from this experiment. Justify your response.
b. A second experiment was conducted to examine the effect of temperature on the hatching rate with the results shown below.

<table>
<thead>
<tr>
<th>No. of eggs</th>
<th>Soil moisture (%)</th>
<th>Temp. (°C)</th>
<th>No. of eggs hatched</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>95</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>25</td>
<td>95</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>25</td>
<td>95</td>
<td>30</td>
<td>3</td>
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<tr>
<td>25</td>
<td>95</td>
<td>40</td>
<td>5</td>
</tr>
<tr>
<td>25</td>
<td>95</td>
<td>50</td>
<td>4</td>
</tr>
</tbody>
</table>

Evaluate the design of the second experiment and propose refinements.
Question 10 assesses *Evaluating biological issues* (EBI). Write an extended response below. 

**Your response MUST refer to biological principles, concepts and ideas.**

Plan your response carefully. If you write more than one draft, indicate which is to be marked.

**Question 10 (EBI)**

Genetically modified foods are derived from organisms that have had specific changes introduced into their DNA by genetic engineering techniques.

Identify the potential risks and benefits of genetically modified foods. Decide whether genetically modified foods should be produced in Australia. Justify your decision.
Part B — Evolution and diversity

Questions 1–7 assess Understanding biology (UB).
Attempt all questions. Write your responses in the spaces provided.
Suggested time allocation: 50 minutes.

Question 1 (UB)

The following table shows the common and scientific names of three organisms.

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cougar</td>
<td><em>Puma concolor</em></td>
</tr>
<tr>
<td>Tiger</td>
<td><em>Panthera tigris</em></td>
</tr>
<tr>
<td>Leopard</td>
<td><em>Panthera pardus</em></td>
</tr>
</tbody>
</table>

Which two are most closely related? Why?

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Question 2 (UB)

One Australian marsupial is known by all the following common names: pygmy flying possum, flying mouse, feathertail, pygmy flying phalanger, pygmy glider, feathertail glider. The same marsupial is known by the scientific name *Acrobates pygmaeus*.

Explain why scientific names are important.

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Question 3 (UB)

Shown below are four homologous structures. How can they be used as evidence to support the theory of evolution?

![Homologous structures](Image)

Human  Seal  Bat  Dog

Question 4 (UB)

Fossils of the fish shown below have been found in rocks near the surface at three different locations. The diagram shows a cross-section of these locations.

![Cross-section diagram](Image)

Triassic  Permian

Are these fossils about the same age or is one significantly older? Explain your response.
Question 5 (UB)

Two of Darwin’s statements are outlined briefly below.

Statement 1

*Organisms reproduce at a rate that could more than double the number of offspring each generation. In natural populations, however, numbers remain fairly constant.*

Statement 2

*There is great variation within a species. No two individuals are exactly alike.*

a. Explain Statement 1 in terms of natural selection and “survival of the fittest”.

b. How does the variation referred to in Statement 2 occur? What is the significance of this variation in terms of the survival of a species?

Question 6 (UB)

After many unsuccessful attempts to control the rabbit population, the Australian Government introduced a viral disease, myxomatosis, which was deadly to rabbits but not to humans. When first used, the virus killed 95% of rabbits infected. Since the mid-1950s, however, rabbit populations have increased and myxomatosis is no longer effective as a population control measure. Explain why this has happened.
**Question 7 (UB)**

The two different species pictured are burrowing animals and live most of their life underground. They are not closely related.

![Image of Australian marsupial mole and European placental mole]

**a.** Name this type of evolution.

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**b.** Explain how they came to resemble each other.

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**End of Part B**

**End of Paper Two**
### 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>
</tr>
</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:</td>
<td>The candidate states terminology and ideas relevant to concepts.</td>
</tr>
<tr>
<td></td>
<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>
<td>• applying knowledge and understanding to a range of complex tasks.</td>
</tr>
<tr>
<td>Investigating biology</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:</td>
<td>The candidate communicates investigative processes by:</td>
</tr>
<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>• evaluating the design of the investigation and the adequacy of the data collected.</td>
<td>• using data to draw conclusions.</td>
<td>• using data to answer questions.</td>
</tr>
<tr>
<td>Evaluating biological issues</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>
</tr>
</tbody>
</table>