**Please read in conjunction with the information provided in the introductory section above.**

## BIOLOGY AND BIOLOGY (HUMAN) TEST SPECIFICATION

### 1 AIMS

The AEA in biology and biology (human) should provide a sense of achievement and a stimulating challenge through encouraging students to:
use biological knowledge and skills to demonstrate a greater depth of understanding of the material within the Advanced GCE;

- show awareness of, and think critically about, the role and value of biology in society;
- apply biological concepts to novel situations and propose solutions to biological problems;
- bring together and use knowledge of the ways in which different areas of biology relate to each other;
- communicate knowledge and understanding of biology effectively.

### 2 CONTENT

The AEA in biology and biology (human) is based on the following sections taken from the GCE Advanced Subsidiary and Advanced Level subject criteria for biology and biology (human).
The AEA in biology and biology (human) will require students to demonstrate:

- knowledge and understanding set out in section 1 of Appendix 1;
- skills of planning analysing and evaluating included in section 2 of Appendix 1
- mathematical requirements included within section 3 of Appendix 1.

### 3 ASSESSMENT OBJECTIVE

The AEA in biology and biology (human) will assess candidates' abilities to apply, and to communicate effectively, their knowledge and understanding of biology by using the skills of comprehension, critical analysis, evaluation, and synthesis and by applying quantitative techniques.

### 4 SCHEME OF ASSESSMENT

Supervision and duration of assessment
External assessment in biology and biology (human) is a three-hour written examination containing four sections taken under controlled conditions. Where necessary information will be provided to allow candidates to access these questions.

i. Candidates will be required to answer one question from each section. A choice of questions will be offered in Sections C and D. Across the paper, as a whole, questions may use a variety of contexts, which are likely to interest and stimulate candidates. There should be a balance within the paper across the areas of biology detailed in this specification. These may reflect the different contexts of biology, for example, social, economic, ethical, environmental and technological.
ii. Section A will consist of a single compulsory question, which principally assesses candidates' comprehension, analytical and evaluation skills.
Candidates will be provided with unfamiliar, stimulus material, which will be based upon a passage, eg an extract from a scientific journal or text. Candidates will be asked to demonstrate their understanding of this material, eg by providing explanations or applying principles of biology to it. In doing so, candidates will need to interpret the information and context and demonstrate a thorough understanding of the related biology.
iii. Section B will consist of a single compulsory, structured question.
This question will assess candidates' interpretational skills. Candidates will be provided with material, which will include quantitative data, which may be related to experimental work in biology. Candidates will be asked to analyse the data, carry out calculations and use their analysis critically. They may be required to propose a solution to a problem, to provide explanations of observations, to suggest additional information to be collected and additional experiments to be carried out, or to comment on the validity of the data.
iv. In Section C, candidates will be required to answer one question from a choice of three.
Questions will be set on a range of topics, which reflect the different branches of biology, eg, organismal and molecular biology. However, the same skill areas will be assessed across the three questions.

The questions will require candidates to draw together principles and concepts of biology from across the different areas of the subject, and show how these apply to the topic concerned. The account should be in essay format but could include diagrams, bullet points etc. as appropriate.

v. In Section D, candidates will be required to answer one question from a choice of three. Questions will be set on a range of topics, which reflect the different branches of biology, for example, organismal and molecular biology. However, the same skill areas will be assessed across the three questions.
   The questions in Section D will assess candidates' critical thinking skills and will require them to demonstrate an ability to develop an argument, and to provide explanations and show an understanding of current issues in biology.

vi. All sections will show the marks allocated to each part of each question. Particularly in Sections C and D, specific marks are allocated to candidates' ability to organise and present information, ideas, descriptions and arguments clearly and logically.

**Use of Resources**

In common with Advanced GCE examinations, the use of dictionaries will not be permitted. The use of any other resources must take full account of the need to ensure fairness to all candidates and the rigour of the assessment. Candidates should be allowed access to calculators. Data needed will be provided as part of the examination paper.

## 5 PERFORMANCE LEVEL DESCRIPTORS

**Distinction**
Candidates:

- use and apply the specified knowledge of biology with no significant omissions;
- select and use the relevant biological information, principles and concepts which are relevant to situations, recognise information that is not relevant, and bring together principles and concepts from different areas of the subject in seeking a solution, demonstrating clear and deep understanding of the relationships between these;
- apply the principles and concepts of biology effectively and efficiently when dealing with a range of contexts and situations, many of which are new to them;
- communicate their ideas with clarity and precision, selecting a form appropriate to the context, and make effective use of a range of appropriate concepts, terminology, data, and techniques in constructing arguments and solving problems;
- select and apply quantitative techniques and tests effectively when manipulating and evaluating data, carrying out a range of calculations in contexts where no guidance is given;
- interpret, analyse and evaluate qualitative information and quantitative data from a range of sources, identifying weaknesses and strengths, and suggest improvements, draw inferences and, where appropriate, relate these to the stated contexts (refer to paragraph 4 (i) of this specification).

**Merit**
Candidates:

- use and apply the specified knowledge of biology with few significant omissions;
- select the relevant biological information, principles and concepts which are relevant to most situations, and bring together principles and concepts from different areas of biology in seeking a solution, demonstrating a clear understanding of the relationships between these;
- demonstrate good and consistent understanding of the principles and concepts of biology, when applying them to familiar and new contexts;
- communicate their ideas clearly and logically, making good use of appropriate concepts, terminology, data and techniques in constructing arguments and solving problems;
- apply quantitative techniques and tests effectively when manipulating and evaluating data, carrying out a range of calculations in contexts where little guidance is given;
- interpret, analyse and evaluate qualitative information and quantitative data from a range of sources, identifying weaknesses and strengths, and draw appropriate inferences.

**Appendix 1**
The Advanced Extension Awards in biology and biology (human) is based on an assessment of the following knowledge, understanding and skills.

## 1 KNOWLEDGE, UNDERSTANDING AND SKILLS

| {PRIVATE} | AREA OF STUDY | AMPLIFICATION |
|---|---|---|
| **1.1** | Biological molecules are based on a small number of chemical elements and frequently consist of monomers combined into polymers. | Basic structure and role of carbohydrates, proteins and lipids. The importance of water and inorganic ions. |
| **1.2** | Organisms are organised on a cellular basis and cells are differentiated according to function. | The ultrastructure of prokaryotic and eukaryotic cells. Aggregation of cells into tissues and tissues into organs which perform major physiological functions. The structure of the plasma membrane and its role in controlling the passage of substances in and out of cells. Passive and active transport. |
| **1.3** | Enzymes are proteins which act as catalysts. | Mechanism of action of enzymes and explanation of their properties in terms of tertiary structure of enzyme molecules. |
| **1.4** | ATP is central to metabolic processes. | ATP as the immediate supply of energy for biological processes. The synthesis of ATP associated with the electron transport chain in the membranes of mitochondria and chloroplasts. The production of the raw materials for ATP synthesis in the light-dependent stage of photosynthesis; glycolysis and the Krebs cycle. The utilisation of ATP in synthesis, as shown by the light-independent stage of photosynthesis. |
| **1.5** | Organisms exchange materials with their environments. | The relationship between size and surface area to volume ratio. Features of exchange surfaces which aid passive and active transport. |
| **1.6** | Substances are transported from and to exchange surfaces. | The principles of mass transport. |
| **1.7** | Species are adapted to survive in particular environmental conditions. | Reference to examples to illustrate the importance of structural and physiological adaptation. |
| **1.8** | Organisms maintain a constant internal environment. | The concept of homeostasis and its importance in maintaining the body in a state of dynamic equilibrium. The role of negative feedback in restoring systems to their original levels. |
| **1.9** | Organisms respond to changes in the external environment. | Detection of stimuli and how this leads to an associated response by effectors. Nervous and chemical co-ordination. |
| **1.10** | Genes incorporate coded information which determines the nature of organisms. | Basic structure and role of RNA and DNA. The nature of the genetic code. Replication of DNA. DNA codes for proteins.<br>Protein synthesis; significance in synthesising enzymes. Applications of gene technology. |
| **1.11** | During the cell cycle, genetic information is copied and passed on to daughter cells. | Mitosis as a process in which daughter cells are provided with identical copies of genes. |
| **1.12** | Continuity of species is maintained by the transmission of genetic information from generation to generation. | Maintenance of gene and chromosome number in cell division and sexual reproduction.<br>The importance of meiosis and fertilisation in sexual reproduction.<br>Progression from monohybrid to dihybrid inheritance. |

| | | |
|---|---|---|
| **1.13** | Selection and evolution can account for the diversity of living organisms. | Genetic and environmental factors produce variation between individuals. Selection can change the frequency of alleles in a population. Isolation and speciation. |
| **1.14** | Species are classified into groups using shared derived features. | The principles and importance of taxonomy. The important features of the five Kingdoms. |
| **1.15** | Energy flows through ecosystems and materials are recycled. | Quantitative consideration of the efficiency of energy transfer between trophic levels. The role of microorganisms in the recycling of nutrients. |
| **1.16** | Ecosystems are dynamic and subject to change. | Factors affecting the stability of populations. The succession process. |
| **1.17** | Human activities can impose far reaching effects on the environment. | The ecological impact of human activities. Reconciliation of apparent conflicts between production and conservation. Management of ecosystems to provide resources in a sustainable fashion. |

## 2 EXPERIMENT AND INVESTIGATION

2.1 Planning

Students should:

a. identify and define the nature of a question or problem using available information and knowledge of biology;
b. choose effective and safe procedures, selecting appropriate apparatus and materials and deciding the measurements and observations likely to generate useful and reliable results;
c. consider ethical implications in the choice and treatment of organisms and the environmental and safety aspects of the proposed procedures.

2.2 Analysing evidence and drawing conclusions

Students should:

a. communicate biological information and ideas in appropriate ways, including tabulation, line graphs, histograms, continuous prose, annotated drawings and diagrams;
b. recognise and comment on trends and patterns in data;
c. understand the concept of statistical significance and apply a simple statistical test to data;
d. draw valid conclusions by applying biological knowledge and understanding.

2.3 Evaluating evidence and procedures

Students should:

a. assess the reliability and precision of experimental data and the conclusions drawn from it;
b. evaluate the techniques used in the experimental activity recognising their limitations.

## 3 MATHEMATICAL REQUIREMENTS FOR THE MATERIAL CONTAINED IN THE CRITERIA

In order to be able to develop the knowledge, understanding and skills in section 1 and section 2 above, which are taken from the Advanced Subsidiary and Advanced GCE level subject criteria for biology, students need to have been taught, and to have acquired, competence in the areas of mathematics set out below.

3.1 Arithmetic and computation

Students should be able to:

a. recognise and use expressions in decimal and standard form;
b. use ratios, fractions and percentages;
c. make estimates of the results of calculations (without using a calculator);
d. use calculators to find and use x n, 1/x and √ x.

3.2 Handling data

Students should be able to:

a. use an appropriate number of significant figures;
b. find arithmetic means;
c. construct and interpret frequency tables and diagrams, bar charts and histograms;
d. have sufficient understanding of probability to understand how genetic ratios arise;
e. understand the principles of sampling as applied to biological data;
f. understand the importance of chance when interpreting data;

g. understand the terms mean, median and mode;
h. use a scatter diagram to identify a correlation between two variables;
i. use a simple statistical test.

3.3 Algebra

Students should be able to:

a. change the subject of an equation;
b. substitute numerical values into algebraic equations using appropriate units for physical quantities.

3.4 Graphs

Students should be able to:

a. translate information between graphical, numerical and algebraic forms;
b. plot two variables from experimental or other data;

calculate rate of change from a graph showing a linear relationship.