External Assessment Report 2015

Subject(s)	Biology
Level(s)	Advanced Higher

The statistics used in this report are prior to the outcome of any Post Results Services requests.

This report provides information on the performance of candidates which it is hoped will be useful to teachers/lecturers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding. It would be helpful to read this report in conjunction with the published question papers and marking instructions for the examination.

Comments on candidate performance

General comments

Entries this year remained at approximately 2,500, and the average prior attainment of candidates moving on from Higher remains a very sound basis for attempting Advanced Higher.

Comments from script markers on this year's cohort reflected the same concerns as in recent years: mainly that many candidates showed ability; however did very well in only some questions, eg in one of the mandatory Units but not both, or in extended writing but not the problem solving. In many cases candidates were not well-enough rehearsed across the whole course to deal with the scale of the assessment.

A good proportion of candidates performed extremely well; they had sound knowledge of a very wide range of topics, the ability to apply this at the right depth in novel contexts, clear and economical expression of complex ideas, and excellent time management.

As in 2014, many markers reported with some concern that there were some centres in which all candidates demonstrated the same knowledge errors in the question paper or were all weaker in one of the assessment elements. Investigation markers reported many examples where all candidates from a centre had a low score.

Performance in this component averaged 13.3/25 this year, a decrease of a whole mark over the last two years: it takes a substantial number of weaker projects to change the mean value by such an extent. The marking instructions have not changed in this period, the instructions and guidance documents have been freely available, and the marking team for this component has been largely the same.

Given that the Investigation component is part of the new Advanced Higher Course, it is advisable that a greater investment of time and supervision would be of great benefit to future candidates.

Average scores for the question paper components were similar to previous years. The mean scores were: 18.4/25 for Component 1, multiple-choice; 34.5/75 for Component 2, the written element; and 13.3/25 for Component 3, the Investigation report. In Component 2, candidates scored markedly better in questions on Unit 1, Molecular Biology. Unit 2 Environmental Biology, scores were comparatively weak compared to previous years. Essay scores averaged at approximately 8/15. Essay B, on DNA, was chosen more frequently (by 55% of candidates) and scored nearly 9/15 compared to Essay A, where the mean score was just less than 7.

Options were as follows: Biotechnology uptake 1–2%, scored approximately 6/20; Animal Behaviour uptake approximately 9%, scored 12/20; Physiology uptake approximately 90%, scored 11/20.

Areas in which candidates performed well

Section B

Question 1(a);(f)(i):

Most candidates recognised the definitions of mutualism, and greenhouse gases.

Question 1(b)(i);(e):

Many candidates spotted the absence of oxygen in the active peat layer and recognised that plankton would reduce light for moss photosynthesis.

Question 5(a)(i) and (b)(i):

Most candidates knew about bonding in carbohydrates.

Question 6(a)(i);(b):

Most candidates recognised hydrophilic signalling, and many were able to interpret how signalling could be controlled by the two drugs.

Question 7(ai):

Many candidates knew the role of Taq polymerase.

Question 8A:

In the essay on membranes, many candidates scored well in section (ii) on structure and (iii) on transport of ions.

Question 8B:

Many candidates performed well in the whole essay, scoring full marks; parts (i) on DNA structure and (ii) mutations leading to tumour formation were well rehearsed.

Options

Biotechnology: Q1(a)(ii), 2(a)(i)(b)(i)(b)(ii), Q4(b) — of the few candidates following this option, a good proportion performed well in these questions.

Animal Behaviour: Most of the questions were done well by substantial proportions of the candidates. Question 2(b) comparing parental care in social insects and primates, and 4(b)(c) on polygyny were the weakest.

Physiology, Health and Exercise: there were many good answers to Q1(a)(b)(c)(i) on hypertension; Question 2 extended response on changes to the heart from endurance training; Q3(a)(b) on determining body composition and 4(a)(ii) on risk factors for Type 2 diabetes.

Areas which candidates found demanding

The question paper is constructed to the same specification each year so that questions sample candidates' factual knowledge and the extent to which they understand concepts at this level. Questions are expected to perform as ‘C’ type and ‘A’ type. A well-prepared average candidate ought to be able to achieve the 'C' type questions. If candidates have ability beyond this, they ought to be able to tackle successfully some of the challenging ‘A’ type questions that follow from syllabus knowledge, or from the interpretation of previously unseen research data.

Although every item in this year's question paper was answered correctly at least a few times, some questions did not perform as intended. Some were more discriminating than intended or did not discriminate as expected.

In a number of cases marks were lost, not because candidates did not know enough biology, but for more mundane reasons.

Some candidates did not read the question correctly. For example, Question 4 in Section B relates to 'transmission' of parasites, yet many candidates lost nearly all the marks by discussing the nature of parasitism.

Question 8A part (i) in Section B required candidates to 'Discuss membranes ... ' in relation to 'organelles and their functions'. However, many candidates simply listed organelles found in eukaryotic cells without any reference to the value of membranes in their role or structure. In the Physiology option, Section C, Question 3, most candidates named a method used to assess body composition instead of describing it.

In other cases marks were lost because candidates did not relate the biology they should know to the context. For example, candidates almost universally recognised 'mutualism' in Section B Question 1(a). However, many then did not keep the concept in mind as the example of mutualism unfolded in the rest of the question. Some candidates also had problems recalling even a basic understanding of gas exchange in photosynthesis. And in Question 5(b)(ii) many candidates could not see the potential osmotic issues if glucose molecules were to be stored individually in cytoplasm.

Many candidates lost two marks in a wrong calculation by not showing working, and some lost a mark for not providing units.

There were some common errors of understanding in many items; as the following examples show:

Section B Question 1

This question is about how mutualism between a submerged brown moss and methanotrophic bacteria reduces methane output in some tundra ponds.

- Candidates who performed poorly in this question missed the important point in paragraph four that the bacteria ‘*use oxygen to convert methane into carbon dioxide*’; ie during methane oxidation, both methane and oxygen are consumed.

- (b)(i) only half of candidates managed to pick data showing that active peat is anaerobic and makes methane.
- (b)(ii) only a small proportion of candidates saw the depletion of both oxygen and methane in the moss layer (between 10 and 20 cm depth).
- (c) many candidates could see that the presence of light in Figure 3 resulted in lower methane output but then lost a mark by not commenting on the statistical significance.
- (d) few candidates scored both marks for describing the mutualism; some got the idea that oxygen is released from photosynthesis however did not see that carbon dioxide from the bacteria is used in photosynthesis to make more oxygen.
- (e) by far the most common answers were about phytoplankton eating the moss, or there not being enough *oxygen* for photosynthesis.
- (g) the question was principally looking for the acceleration of global warming that would follow the loss of this mutualistic relationship.

Question 2

- (a)(i) the concept of productivity was alien to many candidates; others invented units and many missed the time element to give the idea of rate.
- (a)(ii) commonly the factors were not known, or A and B were not designated.
- (b)(i) many candidates did not understand facilitation or could not convey it clearly.
- (bii) approximately half of the candidates scored in this question; acceptable answers were restricted to those involving biotic changes.

Question 3

Candidates' performance in this entire question was poor; candidates were not able to *explain* the ecological changes taking place.

Question 4

The average score for this question was approximately 2/5. Most candidates wrote long, prepared tracts on parasitism in general rather than paying attention to the mark allocation and addressing only methods of transmission.

Many answers showed that there are significant areas of confusion around parasitism and parasite transmission. A better understanding would be valuable in the new syllabus. There is a very good discussion of relevant concepts in Begon (1996, chapter 12), and Townsend (2008, chapter 8) has useful insight into the co-evolution of hosts and parasites that links to the 'Red Queen hypothesis'. The articles introducing micro- and macroparasites (Anderson and May, 1979) are also worth referring to.

Question 6: (a)(ii)

Candidates made various errors in their responses to this question. Some candidates did not 'use information from the diagram' as required, even though they may have had a good general idea of signal transduction. Other candidates did follow the instruction however took the ion flow to be that for the sodium-potassium pump. Other candidates confused enzyme vocabulary in relation to 'activation' and took the drugs to be allosteric modulators.

The context of this question is also in the Advanced Higher (Revised) question paper where channel gating and membrane resting potential in neurotransmission are being tested.

Question 7

As with other questions that asked for explanations, the following questions also proved to be difficult. There are two parts: the first asks candidates what they should know about conventional PCR, in which primers delimit a section of DNA to be sequenced; the second introduces PCR that is done without primers, where any fragment is amplified and compared with databases.

- (a)(iii) Few candidates managed the idea that primers were constructed or designed.
- (b)(i);(ii) Many candidates did not grasp that pathogens are disease organisms, or that they have their own DNA, or that, even smashed up, there would be very little of their DNA relative to what would be in a sample of eukaryotic cells.
- Other candidates thought that pathogen DNA was part of the human genome, like a mutation.

Question 8A

The issue with part (i) in this question was raised earlier in this report; otherwise knowledge was sound and comprehensive. Candidates tend to write everything they know on a theme rather than select to match the mark allocation; they can score well doing this, but can subsequently put themselves under time pressure for later questions.

Question 8B

Candidates performed well in this question; the most common issues were the confusion of base for nucleotide, not mentioning DNA polymerase and mistaking the 5' – 3' polarity. Even if candidates said the polarity correctly, their diagrams indicated confusion. Many candidates knew about okazaki fragments — which are not in the syllabus — but did not all grasp the role of ligase (phosphorylating the 5' ends of the fragments and forming the phosphodiester bonds to join them up).

References

Begon M, Harper JL, Townsend CR (1996) *Ecology 3rd Edition*, Blackwell Science, Oxford
Townsend CR, Begon M, Harper JL (2008) *Essentials of Ecology 3rd Edition*, Blackwell Publishing, Oxford
Anderson RM, May RM (1979) Population biology of infectious diseases: Part 1, *Nature Vol 280, 2* August 1979, pp361-367
May RM, Anderson RM (1979) Population biology of infectious diseases: Part 2, *Nature Vol 280, 9* August 1979, pp455-461

Advice to centres for preparation of future candidates

Although this is the final year of the traditional Advanced Higher Biology Course, there are general matters that will continue to affect candidate performance in the new Advanced Higher Biology Course.

Teachers/lecturers need to be up to date with their subject knowledge in all the syllabus areas in the new courses. For some who did not teach this Advanced Higher, there will be

topics to master for Higher or the levels below, displaced from the outgoing syllabus, and there will be new Biology content where little has been derived from outgoing Highers.

In large part, the content of the Advanced Higher Biology (Revised) Course will form the content of the new Advanced Higher Biology Course. The Revised Course has been running parallel to the traditional course for the last three years, so there are SQA past question papers to help gauge the scope and depth of concepts. These papers are available on the SQA website.

An Investigation component is part of the new Advanced Higher Biology Course, where it forms part of the assessment of Unit 3, a full Unit devoted to the understanding of Investigative Biology. The externally-assessed project report has a different marking scheme to the traditional and revised investigation report. The published SQA Advanced Higher Biology (Revised) past question papers contain questions based on the Investigation Unit; these will be illustrative for how the content might be assessed. SSERC has also published a monograph dealing with the new Advanced Higher Biology material; it is available to download via the Resources page on their website. A further SSERC publication to support investigation planning, data handling and statistics has also been published.

For centres, the issues associated with designing and carrying out investigations will remain the same; these have been enumerated regularly in EA Reports over the years but a few key reminders are given below.

- **Plan for safety.** In some cases, candidates are submitting some very dubious work; eg. where they have variously cultured (and sub-cultured) samples from soil, skin, sink, toilets, rivers presumed to be affected by sewage outfall and 'seeded' material left outdoors for days. Sometimes culturing has been at 37°C.

- Centres must comply with local authority health and safety requirements as they apply to senior candidate investigations. SSERC's codes of practice for Scottish schools and colleges: *Safety in Microbiology* and *Materials of Living Origin* is a useful document to refer to.

- **Know what is being assessed.** The purpose of the Investigation component has been to develop investigation skills by obliging candidates to carry out a project. The assessment element has looked for and evaluated the *investigative process* in the work, to see if candidates have understood the mechanics of designing experiments that might lead to a valid conclusion, and to see if they can make sense of the data they collect.

- Candidates can be aware of the parts of the process better if they limit the number of inputs they vary, and limit the outcomes they measure. Badly designed, an investigation can generate too little data to score much, or so much data that it is overwhelming. It is a more important use of time to repeat the whole of a simpler piece of work to have replicates to compare than to have single sets of data on a wide array of measures.

- A sound protocol with controls, reasonable sample sizes and independent replication will reveal variability in results. Analysis of the data will show if the variability is caused by erratic lab practice, intrinsic variation in material or the treatments that have been planned.

Question Paper: Read questions carefully twice, underlining key words if necessary. In numerical problems, show the working. Units are normally required with data.

In longer data handling questions, the first items will usually help to focus on the main theme. Follow the instructions to refer to specific tables or figures and don't stray beyond these; other material will be questioned later.

It is important to remember any new information given in question stems; it may be providing key information or setting up an idea slightly beyond what has already been provided. Repeating details from the stem will not gain any credit in an answer.

Statistical information: update on Courses

Number of resulted entries in 2014	2518

Number of resulted entries in 2015	2425

Statistical information: Performance of candidates

Distribution of Course awards including grade boundaries

Distribution of Course awards	%	Cum. %	Number of candidates	Lowest mark
Maximum Mark	125			
A	20.5%	20.5%	496	79
B	29.7%	50.1%	720	66
C	26.8%	76.9%	649	54
D	11.3%	88.2%	275	48
No award	11.8%	-	285	-

For this Course, the intention was to set an assessment with grade boundaries similar to those set in 2013 due to the data handling and essay questions alternating each year with respect to the Unit on which they are based.
Overall, the Course assessment proved to be more difficult than intended. This affected all candidates. The grade boundaries were decreased by 3 marks for Upper A, Grade A and Grade C to reflect this.

General commentary on grade boundaries

- While SQA aims to set examinations and create marking instructions which will allow a competent candidate to score a minimum of 50% of the available marks (the notional C boundary) and a well prepared, very competent candidate to score at least 70% of the available marks (the notional A boundary), it is very challenging to get the standard on target every year, in every subject at every level.

- Each year, SQA therefore holds a grade boundary meeting for each subject at each level where it brings together all the information available (statistical and judgemental). The Principal Assessor and SQA Qualifications Manager meet with the relevant SQA Business Manager and Statistician to discuss the evidence and make decisions. The meetings are chaired by members of the management team at SQA.

- The grade boundaries can be adjusted downwards if there is evidence that the exam is more challenging than usual, allowing the pass rate to be unaffected by this circumstance.

- The grade boundaries can be adjusted upwards if there is evidence that the exam is less challenging than usual, allowing the pass rate to be unaffected by this circumstance.

- Where standards are comparable to previous years, similar grade boundaries are maintained.

- An exam paper at a particular level in a subject in one year tends to have a marginally different set of grade boundaries from exam papers in that subject at that level in other years. This is because the particular questions, and the mix of questions, are different. This is also the case for exams set in centres. If SQA has already altered a boundary in a particular year in, say, Higher Chemistry, this does not mean that centres should necessarily alter boundaries in their prelim exam in Higher Chemistry. The two are not that closely related, as they do not contain identical questions.

- SQA's main aim is to be fair to candidates across all subjects and all levels and maintain comparable standards across the years, even as arrangements evolve and change.