External Assessment Report 2014

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 for Advanced Higher Biology increased to almost 2500 this year. Candidates taking the course had prior attainment in Higher Biology, and this was as strong as last year's candidates. The majority of markers, however, reported that this year's question paper performance was generally weaker than in previous years; they thought candidates were less well prepared overall for the challenge of the question paper. (The mean score was about 5% below the average of the last nine years of results.)

Many markers reported with some concern that there were some centres in which all the candidates demonstrated the same misconceptions, or had learned the same factual errors, or had left the same questions unanswered. There was also an increase in markers' criticism of the quality of candidates' handwriting, some of which was illegible.

Candidates' performance in Section A matched that of previous years (19/25). Most candidates find this section straightforward. However, candidate performance in Section B and Section C was poorer.

The question paper is set to the same specification each year, with the same numbers of items that are expected to perform as 'C' type and 'A' type (see Arrangements 6th Ed, p55), and with the same proportions of KU and PS marks. Knowledge and Understanding questions consist of between 68 to 75% of the entire question paper; one third of these KU marks are tested through extended writing. To reach top grades, candidates have to understand and recall course content thoroughly, and must express themselves clearly and accurately.

These requirements are particularly important in the 'essays'. Markers' concerns about candidates' preparedness were starkly reflected in essay scores: these averaged 6.2/15 this year compared to an average of 8.5 over the previous four years. Both titles were attempted approximately equally; essay B, on pollution, was answered marginally better.

In the option *Physiology, Health and Exercise*, the topic that most candidates study (94%), the mean score was 8.8/20 where it is normally 10 or more. The other two options performed as expected. (*Biotechnology* uptake 1–2%, mean 8.5/20; *Animal Behaviour* uptake 4–5%, mean 9.3/20.)

The quality of each candidate's lab experience and the attainment arising out of it are largely under the control of staff in centres. Where staff can invest the time to supervise progress in the Investigation, candidates have a chance to do well. Many Investigation markers expressed concern about the lower level of candidate preparation underpinning this year's submitted Investigation reports. Performance in the Investigation component was 13.4/25, poorer than in previous years: the average mark had been static at 14.2/25 for ten years, so this year is a notable decline.

Most candidates did not perform badly in every component; there were many excellent candidates who managed to put together high scores in all components and gain an A pass (approximately 25%). The range of abilities needed to achieve an A is impressive: sound understanding and recall of all the themes in the course; ability to apply knowledge in novel contexts under pressure; literacy skills to grasp quickly what questions are about and how to assemble an answer; good lab skills and awareness of principles in biological investigation. In centres providing plenty of teacher input, scores were on average higher.

There were a few questions in the question paper that were more challenging than expected, and some that were easier. In addition, there were numerous misconceptions, many of which have been covered in previous External Assessment Reports.

Areas in which candidates performed well

Section B

Question 1(a)–(c): these PS items were relatively well understood given the unfamiliar context.

Question 3(a) and (b)(ii): many candidates knew protein structure and the role of spindle microtubules.

Question 4(a) and (b):the basics of activating trypsinogen by cleavage were well done.

Question 5: on physiological interactions with environment was well done by most candidates.

Question 6: many candidates were clear about the value of pesticides in allowing bigger harvests from intensively farmed land and did the calculation correctly.

Question 7: on the impact of sea temperature increase was well done by most candidates

Options

Biotechnology:

Q1(a) and (b), Q4: of the few candidates following this option, a large proportion performed well.

Animal Behaviour:

Q1 and most parts of Q4 were relatively well done

Physiology, Health and Exercise:

There were many good answers to Q1 and Q2

Areas which candidates found demanding

In Section B, KU items for Units 1 and 2 count for approximately 40 of the 55 marks. Some of the questions that probe understanding are intended to be challenging and are performed well mainly by the best prepared candidates. When item performance is analysed, these

questions have high values for discrimination but a low mean score 'facility value'; poor candidates score badly.

Extended responses are based purely on KU and they all have high discrimination values; their mean scores this year were as follows:

Question B2, 1.6/4 B8A, 5.9/15 and B8B, 6.5/15

Biotechnology Q2, 1.3/5 **Animal Behaviour** Q2, 2.2/5 **Physiology** Q1, 2.2/5.

In these items the questions were straightforward but many candidates had only vague or partial knowledge, or major confusion and errors.

Question B1: The PS items here were relatively well done, (a) to (c), compared to those testing the syllabus knowledge. Knowledge of signalling, transduction and the storage of energy as glycogen were very poor. See the 2013 External Assessment Report (p5) for misconceptions; the same ones abound this year.

Question B2: Most candidates did not define *transgenic*, or know about the source of Ti plasmids, their normal role and how they are manipulated (see 2013 MI).

Question B3: Many candidates did not understand in (b)(i) that spindle microtubules are spanning from MTOC to the centromeres of chromosomes, and in (b)(ii) that the M checkpoint is about chromosome alignment on the spindle equator.

Question B4 This question is about how trypsin formation is under very tight control. Many candidates saw how trypsin might be destructive to the tissues that make it but were less sure about the idea of *acceleration* — each new trypsin joining in on the activation of even more of it.

Question B6: The use of neonicotinoid insecticides is controversial, which the item (c) alludes to. But even without pesticides, other aspects of intensive crop production - field size and monoculture - will continue to affect bee numbers.

Many candidates did not recognise that the word 'however' was denoting a change of tack. They had to recognise that in huge fields of a single crop species, nectar and pollen are only available (though abundant) for a short flowering period. The bees are adapted for a different habitat where there is diversity of plants flowering at different times relatively near their nests.

Question 7: The only concern here was to do with the biology underlying coral bleaching. Many candidates stated that the zooxanthellae die in the host, while others stated that they are expelled and then move away to better conditions. Current understanding is that the algae are initially expelled from host cells into the polyp gastric chamber; when expelled to open water, they may survive only a few days.

Question B8. Knowledge was weak in both long essays. The content of the two titles has been tested before, so the better-prepared candidates did well and those

with poorer knowledge fared badly. (See previous years' External Assessment Reports for a review of conceptual errors — this year's are the same).

In 8A it was common to see greenhouse gases methane and CFC produced by burning, acidity as increased pH, and saprotrophs being a trophic level above predators.

In 8B, many candidates did not recognise the distinction between toxic pollutants and biodegradable organic pollutants. Persistence, for example, as shown by DDT, opens up ideas of toxin accumulation and magnification, which should be defined or explained.

The distinction between organic and inorganic was a problem for many, and biodegradable organic pollution was problematic. Instead of thinking of paper mill waste or sewage, many candidates talked about artificial fertilisers, even pesticides, leaching off farmland and causing eutrophication effects. The story required was about BOD changes, reduction in available oxygen and the loss or survival of susceptible and favoured species.

Options

Biotechnology and Animal Behaviour

Only a small sample of scripts were analysed for these options. The following questions proved more difficult than expected:

Biotechnology: Q1(d); Q2; Q3(a)

Animal behaviour: Q1(c); Q2; Q3(a)(c); Q4(b iii)

Physiology

Question 1: Many candidates had difficulty sorting out the concepts of *risk* and *risk factor*. To reduce the risk of CVD, exercise should have an effect on known risk factors, ie the variables known to be correlated with the development of diseases. The MI gave credit for knowing some conditions and explaining how exercise can reduce the risk of them developing.

Question 2: BMI was commonly confused with BIA, which affected answers to both (a)(i) and (a)(ii).

Questions 3 and 4:

There was in general a weak understanding of lab methods for measuring or deriving physiological parameters — obtaining 'oxygen consumed' for indirect calorimetry and VO_{2max} in maximal fitness testing.

Advice to centres for preparation of future candidates

Problem solving questions items account for 20/75 marks in the entire question paper, and most of them (up to 10 marks) appear in the long data question. If candidates perform badly it is not due to the difficulty of the PS questions, it is mainly because candidates do not have sufficient knowledge.

However, even though the context each year is unique, centre staff are advised to go over SQA past paper data questions with candidates to show how they should be approached.

Staff are advised to read the text and skim through the tables, graphs and diagrams with candidates — just as candidates ought to do themselves in the exam. Note the 'pointers' in the questions ('use data', 'refer to figure 2', 'explain ... for **2** marks'). In addition, if error bars or other error measures are given, they need to be considered when evaluating if treatments have been effective. (See the 2008 External Assessment Report and the Advanced Higher Biology Arrangements p56.) Advise candidates to read the **whole** text and the questions before starting to answer.

In extended responses, candidates need to define the terms they are using. They should make a brief plan relating facts to the correct section of the title; this will also allow a double check that the essay content matches the question asked. Planning needs practice.

Accuracy of concepts and expression needs to be checked by someone who knows the Biology; peer marking using published marking instructions (MI) is unreliable for this purpose. Teachers can also be unreliable in the application of MIs when assessing candidates. Centres are advised not to stray from the MI by awarding marks for (even correct) statements that are not included; this is lenient marking and misleads candidates about national standards.

Staff should scan through Investigation Reports in draft form to check that simple things have been done correctly; candidates of all abilities can lose five or six marks on technical aspects of the Report and that will reduce a good study to an average score. Check for:

- suitable title, contents page, page numbers, summary (Aims and findings only)
- aims and (testable) hypotheses stated **in the introduction**
- correct referencing (see below)
- raw data submitted (in Appendix); averages calculated to a sensible number of decimal places
- a table to support each graph and a description of results/trends for each

For candidates to access 'A' marks, they should have repeated experiments to generate 'replicate' data. Candidates should be advised not to plot these separately but to plot the average. They can then discuss in the Evaluation how much the repeats differ from each other and explain how this could have happened.

The prescribed reference style is the Harvard system. The requirements are illustrated in the SQA Advanced Higher Candidate Guidance document. Centres are advised to provide candidates with a copy of this document so they are aware of what is expected of them.

Notes

Data source

This year's data question was based on Marette A, et al (1992); Abundance, localization, and insulin-induced translocation of glucose transporters in red and white muscle. Am. J. Physiol. 263 (Cell Physiol. 32): C443-C452, 1992.

Coral bleaching

Reef corals live in shallow water with sufficient sunlight for their symbiotic algae. They are already near the upper thermal tolerance limit for both symbionts. Corals actively expel their zooxanthellae in intense light when temperature increases either sharply for a short period of time (+ 3 - 4^{O}C over several days) or moderately for a longer period (+ 0.5 -1.5^{O}C over several weeks). Expelled algae have a limited lifespan outside the coral, possibly about 5 days and are unlikely to be a source for re-infection.

Within the coral (host gastroderm cells) and outside, algal decline is associated with the loss of photosystem 2, damaged by exposure to high light intensity. There is evidence that the damage is occurring while algae are in the host cells, causing some of the pigment loss. Algal mitosis increases while they are still in the coral gastric cavity following expulsion from the host gastroderm. (Various research papers, 2000 - 2008, eg. Hill R and Ralph PJ (2007) Post bleaching viability of expelled zooxanthellae ... Mar Ecol Prog Ser, Vol. 352:137-144, 2007*)*

Statistical information: update on Courses

Number of resulted entries in 2013	2458

Number of resulted entries in 2014	2518

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	21.6%	21.6%	545	78
B	27.0%	48.7%	681	66
C	24.3%	73.0%	611	55
D	12.2%	85.2%	308	49
No award	14.8%	-	373	-

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.