May 2017 Environmental systems & societies subject report

Environmental systems & societies

Overall grade boundaries

Standard level

Grade:	1	2	3	4	5	6	7
Mark range:	0-11	12-21	22-34	35-45	46-56	57-67	68-100

Standard level internal assessment

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0-4	5-8	9-13	14-16	17-20	21-23	24-30

The range and suitability of the work submitted

This was the first session that assessed the new curriculum and new IA assessment model. Additionally, it was the first session in ESS to use online marking and this was not without its share of problems. Principal among these was standardization and the impact of failed qualification and marking seeds out of tolerance. Adjusting a moderator's scores by a moderation factor is not the same as requiring all moderators to mark to the same standard. Clearly there is a learning curve for all involved, especially in the selection of suitable "seeds."

Candidate performance against each criterion

Identifying the context

The inclusion of this criterion is a good fit with the age-old laboratory report model in which a student provides a background to what is being studied. This was well done by many candidates and reasonably well marked by most teachers. A common problem in this criterion was the failure to clearly identify an environmental issue. This was especially problematic when students chose to embark on traditional practicals, for example the effect of different colour light filters on photosynthesis in *Elodea*. This could be better done, for example, by looking at the effect of turbidity and then tying it in to silt-laden water as a result of deforestation. This is where a teacher's guidance is essential. Teachers should warn students

regarding discussions that are not referenced, particularly in local examples. The fact that a student believes something to be the case does not mean that the statement needs no referencing. Another place where students lost marks was in framing a clear research question, another skill that perhaps needs to be taught prior to starting the IA. For example when a student indicates as a research question, "What is the effect of pollution on plants?" this is so imprecise as to give very little idea of what is to be investigated. It could be soil pollution, air pollution or water pollution (and one hopes that it will not be all three!) A better question would be "What is the effect of salt concentration on the germination of radish seedlings?" Finally students lost points for failing to establish clear links between their research question and the environmental issue.

Planning

This criterion has three aspects (to stay faithful to the previous nomenclature). The first is standard practice for many students and schools, i.e. being able to establish a plan that collects sufficient relevant data. There are still some issues here, mostly with carrying out sufficient work, and this was usually spotted by teachers who marked accordingly. The second criterion was trickier as it asks students to justify their sampling technique, not merely describe it, in order to achieve the highest descriptor. This implies indicating how subjects for a survey will be selected and why this method, and no other, was used, for example indicating why a $1m^2$ quadrat will be used instead of a $2m^2$ quadrat. (Convenience or possibilities could well be a justification, but it must be made explicit and it must be justified as opposed to described or outlined. Students are required to address ethical considerations and risk assessments where appropriate. It is hard to imagine a practical where this is not appropriate. For example, even when using secondary data, the relevant ethical consideration is to ensure that the student is not engaged in purposeful bias, and this was mentioned by better candidates. Many students indicated the need to guarantee anonymity to subjects when engaging in survey work. Others indicated that when approaching strangers in order to ask them to fill out a survey, this was more safely done in the company of a friend. When working in laboratories students would be expected to mention standard safety equipment, gloves, aprons, goggles, etc. Even relatively harmless practicals, such as the effect of light intensity on photosynthesis of *Elodea* deserves mention of the possible risks involved when working with hot lamps and electrical equipment in close proximity to water. Fieldwork can also be dangerous, especially when working alone; for example a student should realize that working in the intertidal zone can be dangerous, especially in wave exposed areas and these risks should be mentioned.

Results, analysis and conclusion

As with the previous model, this criterion was difficult when the plan was poor or did not generate sufficient data. Teachers should provide guidance, for example questioning whether the student's proposal will provide sufficient data for a robust analysis. This is one of the problems with studies on secondary data where the purpose is to establish a correlation (or the lack of one) between two parameters. There is little else that can be done with these data in some cases and this does not make for a thorough analysis. One point that may be confusing in this new model is the difference between the first and second aspect. Is a graph of analysed data scored under the first aspect, or the second? The processed data upon which the graph is built should be present in the report. A well-constructed graph of raw data may be considered under the first aspect; however, as with the previous model, it is

not considered to be analysis. Teachers should spot check calculations to ensure they are correct, moderators will do this and it is a pity when students lose points for careless mistakes. One difference between the current and the previous model is that in awarding marks in graphs and tables for RAC, meaning is most important, and not form. So units in the table, or inappropriate numbers of decimals in a calculation would not result in an automatic loss of marks. These sorts of mistakes will be addressed in COM for failure to follow conventions. There are also some issues with quality of data. For example if the practical will generate 30 responses to a survey of three questions and the only thing that is done with the data is to generate some pie charts, clearly the scope of the work is not sufficient for this level of assessment.

Discussion and evaluation

The first aspect for this criterion is to evaluate the conclusion in the context of the environmental issue. This is quite different from the previous model. Students are expected to see how their conclusion measures up what might be known regarding the issue. For example if the student concludes that salinity does impact germination rates in radish seeds, how is this related to the original problem? Is the conclusion in keeping with literature? If it is in keeping with the literature, is this a trustworthy conclusion? Much can be justified with the simple calculation of a standard deviation. The second descriptor has not suffered much change from the previous model Teachers should be aware that the highest band requires the **discussion** or strengths and weaknesses and not a description. A table of strengths and weaknesses, may provide a very useful scaffold for some students but it's difficult to achieve full marks with a table that is not accompanied by text. Another tricky point is that the third descriptor requires students to suggest modifications **and** further areas of research. Further areas of research are understood to be qualitatively different from what has been done, and not just more of the same. Not many candidates reached the full 6 in this criterion.

Applications

This is a completely new criterion and measures a student's ability to apply their research, at least as a thought experiment. Again, students need to read the descriptor carefully. One well thought out application with an evaluation of pros and cons is all that is needed to achieve full marks for the criterion. Students tended to list several applications (unnecessary) and failed to provide an evaluation of the strategy they were proposing and thus lost marks. It is important to consider that the solution does not need to be based directly on the data generated by the study, it is appreciated that the student's results may be confusing, and this should not have a knock-on effect on APP.

Communication

This is another new criterion and most teachers have marked it accurately. A well-organized report that is weak in many of the other criteria, may still score top marks in this one; however the failure to follow some conventions may result in lowered marks. For example poor titles in tables, inclusion of units in individual cells, lack of horizontal / vertical axes labels in graphs. All these should be considered when marking this criterion.

Teaching of future candidates

Teachers are allowed to give feedback on a first draft and this was evident in some practicals and sadly lacking in others. This is a fundamental part of the learning process and teachers should use it appropriately.

A good rule of thumb for evaluating the suitability of a student's proposal is to ask if a student of a much younger age could carry out the research. If the answer is yes, probably the student needs to look for a more complex question.

There is no requirement for labelling the different sections of the report to coincide with the criteria. This means that evidence for a descriptor may be found in a different section of the report. So a statement that evaluates the conclusion may be found in the APP section of the report. This should not be penalized. Weaker candidates should however be encouraged to label their reports according to the criteria as it may help to clarify thinking. Raw data must be tabulated, a list is not appropriate.

Teachers should be aware that moderators are instructed to stop reading when they reach the word limit. All work beyond this limit will not be considered. Moderators will also not read appendices.

Students may include screen shots of survey questions and these will not be included in the word count. On this same topic, it is not appropriate to include all the raw, untabulated results of a survey, (one practical had fifty extra pages of survey results).

Teachers should not award a number (from 0 to 6) for each of the three descriptors in a criterion and then take an average. A best fit model should be used in order to award the level achieved.

Standard level paper one

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Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0-5	6-10	11-15	16-18	19-21	22-24	25-35

General comments

Most of the 57 G2 respondents confirmed that the difficulty of Paper 1 was 'appropriate'. When compared to the M16 Paper 1, 54.39% of respondents considered the M17 paper to be of a similar standard whereas 10.53% respondents thought it was easier and 21.05% believed it to be more difficult. The clarity and presentation of the paper was considered to be good to excellent by 91.23% and 96.49% respectively. The majority of respondents also agreed that the questions were accessible to all candidates with learning support and irrespective of religion/belief system, gender or ethnicity.

Other salient points from feedback from G2 respondents include:

- The change in Paper 1 to cover the case study was a good decision.
- The Resource Booklet was clear and easy to read.
- The use of colour in the Resource Booklet significantly improved the clarity of the figures.
- 1 hour to complete this paper was very tight and some students did not finish.
- The case study was considered as being 'good' and 'interesting'.

Following the changes to the curriculum and corresponding changes to the format of the paper we are unable to directly compare this paper to previous years. The previous SL Paper 1s' consisted of short answer questions with a total of 45 marks. This session the exam paper consisted of the case study and associated resource booklet that carried 35 marks.

Summary of mean and standard deviation marks:

	Mean Mark	Standard Deviation
Overall (11711 candidates)	14.43	5.85
English scripts (11029 candidates)	14.56	5.87
Spanish scripts (639 candidates)	12.04	4.71
New schools (1500 candidates)	13.68	5.84

The lower mean in Spanish needs further investigating and monitoring over the future. Historically the marks for the Spanish scripts have commonly been lower than the overall mean mark. For example in M16 the overall mean was 20.26 compared to 17.93 for Spanish scripts.

The areas of the programme and examination which appeared difficult for the candidates.

- Mathematical calculations which included calculating natural increase rate and using the correct units.
- Interpretation of graphical material, including identifying trends and units.
- Using information in the resource booklet to support their responses.
- Sometimes candidates did not read the question carefully and gave a response that did not address the question asked, e.g. question 4 asked for an animal but many candidates gave a plant. In some cases candidates did not link their response directly to the question.
- Factors that influence the natural increase rate.
- Knowledge of the factors used by the IUCN Red List to classify species.
- Understanding the environmental impacts of hydroelectric power schemes.
- Distinguishing between global warming and ozone depletion.
- Knowledge and understanding of climate change and mitigation e.g. understanding production of biofuels, role of crops in absorbing carbon dioxide and that carbon dioxide is released when biofuels are used.

The areas of the programme and examination in which candidates appeared well prepared.

- Using the data within the resource booklet to list two biomes.
- Understanding the threats to biodiversity and conservation issues.
- Understanding the population pyramid.

The strengths and weaknesses of the candidates in the treatment of individual questions.

Q1. Most candidates were able to ascertain the correct information from the resource booklet. Occasional errors involved giving desert as a biome or answers that were too vague such as ‘forests’.

Q2a. The majority of candidates did not provide the level of detail required. E.g. they stated that climatic factors resulted in higher biodiversity in the Atlantic Rainforest than the Cerrado without referring to differences in insolation/rainfall/temperature or they suggested deforestation affects biodiversity without identifying the location where biodiversity is most adversely affected.

Q2b.The majority of candidates performed well on this question. Most common responses included high biodiversity, high number of endemic species, variety of ecosystems and the provision of natural capital.

Q3. In general candidates did not answer this question well. The majority were unable to link the threats they gave to the IUCN Red List criteria e.g. how deforestation is linked to habitat loss and increase fragmentation of the habitat; or how hunting can result in a reduction in population size and change in the geographical range of the species.

Q4. Most candidates performed reasonably well on this question achieving one or two marks. The most popular answer was Golden tamarin as they are aesthetically attractive or cute. Candidates that chose an alternative animal often struggled to provide a second reason. Unfortunately, a large number of candidates selected a plant and hence were awarded no marks.

Q5a. Many candidates struggled to calculate the natural increase rate (NIR) correctly. Some candidates failed to apply the correct units. There were a significant number of candidates that did not attempt either of the calculation questions in this paper.

Q5b. Many candidates were unable to identify migration as a factor that affected NIR. Many responses incorrectly suggested that the NIR did not take into account the crude birth rate, death rate or indigenous tribes. Some candidates did not appear to make the connection that the question was asking why the actual NIR was lower than the calculated rate in Q5a.

Q6. Most candidates achieved some marks for this question, with many achieving full marks. A common error was only to describe the illustrated age-gender pyramid and not suggest how it may change in the next 30 years. Many recognised that over the years it would become an aging population with a decrease in birth rate. Few students recognised that Brazil is currently at stage 3 and moving to stage 4 of the demographic transition model or that the growth rate would decrease, although the overall population would initially continue to rise.

Q7. There was a high variety of responses to this question with many achieving full marks. However, a signification number of responses either did not address the question or were too vague e.g. 'reduction in air pollution / damages ecosystem'.

Q8. Although many candidates correctly answered this question, others struggled to use the data in the resource booklet to calculate the average annual increase in gross domestic product or forgot to include the units. A significant number of candidates did not even attempt the question.

Q9a. Most candidates scored at least 1 mark on this question although some responses lacked the necessary detail or did not include the correct units as specified on the *y*-axis in Figure 8.

Q9b. Many candidates were unable to explain why the level of grain production had significantly increased with only a relatively small increase in the amount of land used and simply suggested that the increase in production was due to an increase in land used. Those that gave a correct response often referred to improvements in technology or use of fertilizers that have allowed grain production levels to increase without increasing the amount of land used. Some candidates did not link 'cause' with 'effect' i.e. they stated 'use of fertilizers' without linking it to an increase in grain production.

Q10a. Many candidates focused on biofuel replacing the use of fossil fuels and how it produced less pollution than gasoline and therefore achieved 2 marks. Common errors included: (i) suggesting that when biofuels are used they do not produce any greenhouse gases; (ii) stating that biofuels produced less GHGs without reference or comparison to fossil fuels; (iii) discussing the disadvantages of using biofuels even though the command term was 'explain' and not 'evaluate'. Few candidates recognised that carbon dioxide is absorbed by the crops used to make fossil fuels or that its use could be considered carbon neutral.

Q10b. The majority of candidates achieved at least one mark, with some good responses scoring 2 marks for this question. Common errors included stating two limitations (rather than the one specified) or not outlining the impact of the limitation given (e.g. a reduction in food production could lead to food shortage, famine or increase in food cost).

Q11. There were very mixed responses to this question. Many candidates outlined the change in the biocapacity and ecological footprint over time but did not relate this correctly to a reduction in sustainability. Some candidates misinterpreted the graphs and suggested that a decrease in biocapacity showed that land was being better cared for or that the rise in the ecological footprint showed that the population was living more sustainably.

Q12. Marks varied greatly from 0 to 6 marks. A significant number of students gave excellent well-argued responses covering key points of evidence, limitations and providing a clear opinion/conclusion. However, a number of responses failed to discuss any evidence or limitations from the resource booklet that either supported or contradicted the values identified in the surveys. Some responses were too generalised lacking the detail required or providing a clear opinion or conclusion.

Recommendations for the teaching of future candidates.

- Read the question carefully and thoroughly.
- Ensure the meaning of each command term is fully understood.
- Practice mathematical calculations.
- Include units on all mathematical answers.
- Practice interpretation of graphs and sets of data.
- Consider the number of marks that are awarded to a question and ensure that enough information has been included to earn full marks (e.g. reasons, impacts, limitations or examples).
- Give specific answers to questions. Avoid using generalised words or phrases such as “eco-friendly”, “green”, "pollution", "emissions", "affected by" as these are too vague for credit. Be specific in responses, for example, if a habitat is being destroyed, indicate why it is being destroyed. If pollution is being emitted, what kind of pollution and through which process.
- Ensure that writing is clearly legible and avoid writing outside the response box.
- Attempt all compulsory questions and do not leave any blanks.
- Cover the whole syllabus in sufficient detail. This includes ensuring students have a knowledge and understanding of:
    - Factors that influence natural increase rate of a population.
    - Criteria use by the IUCN Red List to classify species.
    - Environmental impacts of renewable sources of energy including hydroelectric power.
    - Global warming and ozone depletion and are able to differentiate between these two environmental issues.
    - Climate change and mitigation.

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Standard level paper two

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0-5	6-10	11-16	17-24	25-32	33-40	41-65

General comments

The areas of the programme and examination which appeared difficult for the candidates

There were a few areas that stood out as being difficult for students to score well, including calculations involving %; pollution management strategies and practical procedures for measuring productivity. With regard to the latter, although the new IA only addresses a single investigation, students should be prepared to describe and evaluate the full range of practical procedures still present in the syllabus.

There were also some areas of the programme in which a large proportion had picked up significant misconceptions. The first of these is a constantly recurring confusion over there being a link between ozone depletion/ozone holes/UV radiation and global warming/climate change. Tropospheric ozone certainly makes a contribution to global warming both directly and indirectly. However, the depletion of ozone in the stratosphere and UV radiation make no significant contribution at all.

Another misconception, even propagated by some textbooks, is that biomagnification occurs due to higher trophic levels “eating a greater quantity”. There is no quantity of a 10% salt solution, for example, that could be added to a vessel containing pure water that would increase its concentration beyond 10%. Its concentration could, however, be increased by subsequently boiling off a quantity of the water. Similarly there is no quantity of polluted food taken in by a higher trophic level that could in itself cause a higher concentration in its biomass. It is the RESPIRATION of the biodegradable biomass that leaves the non-biodegradable toxin in higher concentration. [Fortunately, given the specific question asked on this exam, students could have gained full credit for simply identifying that biomagnification is shown by 'increasing concentrations along the food chain' …without further explanation.]

A more minor but common misconception was that nearby threats to a system reduce the resilience of that system. Resilience is the ability of a system to resist such disturbance …the presence or absence of that disturbance will not affect this inherent ability within the system. Removing a threat doesn't make a system any more or less potentially able to resist it.

A new challenge this year that proved difficult for many candidates was the Section B part c questions that were being assessed using markbands rather than the previous list of marking points. This meant that a larger proportion of marks (and a similarly lower proportion in part b questions) were allotted to the higher order skills to analyse/evaluate/argue/draw conclusions etc. Weaker students were often able to pick up a few marks for relevant knowledge, but generally missed out on the full credit as they struggled to link their knowledge statements, examples etc into an effective line of argument and analysis.

The areas of the programme and examination in which candidates appeared well prepared.

Generally students were well prepared regarding a wide range of factual knowledge statements, doing particularly well on Section A and Section B part a and b questions. Extracting data from graphic models and tables (2a; 3c; 3d) often gained full credit. Similarly topics of water availability in agriculture and the phenomenon of eutrophication showed some very thorough understanding amongst a large number of candidates.

The strengths and weaknesses of the candidates in the treatment of individual questions.

Q1 (a) Only around half the candidates were able to identify solar energy as the energy source for food chains.

Q1 (b) Great majority were able to identify plants/primary producers as base of food chain.

Q1 (c) Most were able to identify DDT as a pesticide …students should be advised that where question specifies a single response it is not a wise strategy to offer a selection of responses.

Q1 (d) Very few candidates were able to apply these terms of “bioaccumulation” & “biomagnification” appropriately …some confused the two; some made no reference to them as required by the question. More were able to identify biomagnification correctly than bioaccumulation.

Q1 (ei) Most were able to identify predation but a surprisingly large number failed to do so.

Q1 (eii) The great majority were able to identify benefits to both populations.

Q2 (a) The vast majority correctly associated cotton with highest water stress.

Q2 (b) Majority of candidates could identify at least one appropriate strategy …incorrect responses were generally due to being too vague or inaccurate e.g. ‘better irrigation’; ‘crop rotation’;

Q2 (c) Most candidates could come up with a couple of valid causes of water stress …incorrect answers again were often too vague e.g. ‘growing lots of crops’ and a significant number mistook water stress for flooding.

Q3 (a) The majority of candidates were unable to calculate a % increase.

Q3 (b) Most could identify CO_2 as a greenhouse gas …but a surprisingly large proportion associated its impact incorrectly with the ozone layer/depletion and UV radiation.

Q3 (c & d) A considerable majority correctly identified changes shown in the data and offer valid explanations.

Q3 (e) Only a minority of candidates could offer an example of adaptation strategies.

Q3 (f) Most candidates identified one valid reason for differences between countries …incorrect answers were again too vague, e.g. ‘economics’; ‘politics’ …there needed to be at least a degree more

explanation. Responses tended to focus on economic/technological differences rather than the geographical and cultural.

Q4 (a) Question 4 was the least popular question and generated very few good responses. In part (a) most candidates focused on energy losses in the atmosphere before reaching the vegetation …which was not addressed by the question.

Q4 (b) A good proportion of candidates gained some credit for describing a protocol to estimate population size, but few could go on to find productivity.

Q4 (c) Most could link net productivity and natural income with sustainable harvesting …although some confused natural income with financial gain. Very few were able to evaluate this in different contexts however, particularly so in regard to the weakness in these quantities/models.

Q5 (a) Question 5 was a popular choice. In part (a) the majority could identify biodiversity as a factor contributing to resilience; other factors were less commonly listed or too vague/confused to gain credit.

Q5 (b) A very significant majority were able to gain over half the available marks through a description of eutrophication. Few were able to demonstrate a complete and valid positive feedback loop, commonly seeing it as just an ongoing process with lots of impacts (no feedback).

Q5 (c) Responses were very generally quite poor with the vaguest of strategies, e.g. 'banning the pollutant'; 'limiting the use of the pollutant'. Also, many responses failed to make a clear/valid distinction between preventative and limiting strategies.

Q6 (ai & aii) Question 6 was a quite popular choice. Part (a) very rarely scored full credit with a lot of responses going for non-mineral inputs and outputs (e.g. water, sun, CO_2 etc).

Q6 (b) Most candidates were able to name a few relevant strategies for managing solid domestic waste. However, credit was generally less than maximum because responses focused on evaluating the strategies (particularly their weaknesses), which was not required by the question. Responses would have scored more by identifying further modifications or other strategies.

Q6 (c) A significant proportion of responses identified the fundamental relationship between food/waste production and carrying capacity …but then did not go far beyond this in exploring how these are influenced by agricultural techniques/management strategies/geographical and social factors and so on.

Q7 (a) Question 7 was the most popular choice. A good proportion of candidates could identify at least a couple of factors affecting genetic diversity although further answers were commonly too vague for full credit, e.g. human influence; genetic engineering. A significant minority mistakenly addressed species diversity in communities.

Q7 (b) A significant minority showed a clear understanding of the differences between stratospheric and tropospheric ozone and their impacts. However, a large majority showed profound confusion by linking ozone depletion in stratosphere with global warming and climate change. Many made no distinction between stratospheric and tropospheric ozone.

Q7 (c) Most candidates were able to distinguish different value systems …although their distinctions were commonly vague and somewhat caricatured/simplistic. A significantly smaller group were able to link the value systems with specific conservation strategies/approaches.

Recommendations for the teaching of future candidates.

There are clearly a few areas of the syllabus identified above that would benefit from more attention. Aside from this, there is the issue of addressing the necessary skills to score well on Section B part c questions. Several strategies could help to increase scores here.

Although candidates should, of course, focus on the topics explicitly suggested by the terms of the question, they should also scan quickly through all other areas of the syllabus for any items that may be relevant to the particular question. These responses are partially assessed on the BREADTH of understanding they demonstrate. Ensuring their response explores different contexts …different societies, ecosystems, value systems, perspectives etc., will also contribute to this quality.

Also, since higher order skills are required for full credit, students should attempt not just to provide relevant knowledge statements and examples, but evaluate them (strengths and weaknesses). Examples are important but they should be clearly linked into the argument/analysis …it needs to be shown HOW they are relevant. EXPLICIT conclusions that are clearly LINKED to evidence given will also benefit scores on these questions.