Environmental systems and societies standard level

Contents

Grade boundaries

Standard level overall

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 8	9 - 17	18 - 26	27 - 38	39 - 49	50 - 61	62 - 100

Standard level internal assessment

The range and suitability of the work submitted

- There was an increase in lab/home-based experiments and local fieldwork; many showed innovation. Students were able to complete fieldwork in and around their home areas. Students used equipment borrowed from school, could access their school or used home items for lab-based practical work. There were many investigations using surveys or secondary data. Very few computer simulations were carried out.
- A few literature review/essays were submitted. These do not match the criteria.
- A good range of suitable topics were investigated despite pandemic restrictions. Not many reports considered Covid, apart from looking at air pollution changes due to lockdowns.
- Seed germination or growth with acids, fertilisers or a pollutant of some type (salinity being the most common) was a popular experimental topic.
- EVS and GDP are very common subjects for surveys, followed by EF.
- Many reports included Covid restrictions in the risks/ethics section or in the evaluation. Some indicated they could not collect enough data or had to change their method to accommodate Covid regulations.

Candidate performance against each criterion

CXT

- Quality of research questions (RQ) was better this year, most were relevant to ESS. The common missing elements were specifics on variable, time scale or location. There was limited use of genus and species names for investigations involving plant species. The main weakness of this criterion was that the RQ was not fully focused, eg 'what is the impact of migration from country *X* on solid waste of four different regions of country *Y*'.
- Environmental issues (EI) are being stated but the impact of the EI was not always covered. Many candidates were able to describe a variety of environmental issues such as climate change, acid deposition, air pollution – common knowledge; however, fewer candidates were able to make tight connections between the RQ and the EI.
- Lack of theory/secondary data/research to back up EI in many reports.

PLA

- Planning was done fairly well, very few students had no planning section.
- Plans for secondary data should say how the original data was sampled/used by the student and not rewrite the original data collection from the source.
- Very poor plans are commonly unrepeatable due to a lack of information.
- Justification of the sampling strategy was often a weakness.
- A translation the survey questions should be given if needed.

- Details beyond the website are needed for secondary data extraction.
- Risks & safety seem to be written as an after-thought and are generally not well done.
- Risk assessments/ethical considerations of using secondary data are rarely considered.
- Students who develop a method for laboratory or fieldwork-based experiments tend to achieve higher levels in this criterion as they can plan to collect sufficient relevant data (eg 5x repeats).
- Questionnaires should be included in the body of the report, not in an Appendix.
- Method for surveys tend to lack detail. Questionnaires have questions that are not relevant to the RQ such as gender/age. If this is used as general data, it needs to be stated. Questions often have inappropriate vocabulary, eg ESS terminology/'technocentric' when being sent to younger students and adults who may only be able to guess at their meanings. Students need to be more explicit as to how and to whom the questionnaire will be sent.

RAC

- Most candidates were able to construct tables and graphs.
- Poorer work had graphs of raw data and no analysis at all.
- Commonly raw data was not included but added to an appendix while processed data was presented with only basic calculations of mean or sometimes standard deviation.
- The inclusion of tables and graphs that had been copied and pasted from the internet is not appropriate as the only data.
- A good number of candidates carried out detailed statistical analyses such as Pearson's correlation coefficient, ANOVA test, and chi-square analysis. All candidates should be encouraged to carry out analyses such as these, that are more complex than simply calculating an average or a percent.
- The conclusion was generally reasonable.

DEV

- Most of what was written in the last three reports applies.
- The evaluation of the method is very variable; students struggled to discuss their results in relation to the context and EI.
- Connections are not always made between the conclusion based on the results and the original environmental issue described in CXT. Some students do this well by using supporting literature and data.
- The appropriateness of the method used and the way the plan was carried out are not often addressed. Teachers needs to discuss the work and findings with their students and ask probing questions, such as: "what might you do differently?" or "how confident are you of your findings and how could you increase your confidence level?" A strength of the method shouldn't be that they were able to obtain the data without too much work.

APP

- Most of what was written in the last three reports applies.

- Many students give a wide variety of solutions to the environmental issue without providing sufficient detail or evaluation.

COM

- Reports are generally well-constructed, the format is organized, and appropriate terminology is reasonably well employed.
- Use of ESS relevant terminology could be improved.
- Most students kept to the 2250 word count.
- Students commonly forget titles, units or headings in tables/graphs.
- Several students used an appendix/appendices. These are not looked at.

Recommendations and guidance for the teaching of future candidates

- Teaching statistics - teachers must help students to consider why they would use each statistical method and what the results mean to their work.
- Provide students with opportunities to handle significant quantities of data prior to their IA.
- Encourage students to use appropriate terminology in discussions, so that ESS terms become familiar and can be included in reports.
- Students need clear guidance from schools regarding the IB's experimentation policies and academic referencing.
- Teachers must give students support in developing a fully focused research question that will provide sufficient data.
- Students need instruction on how to construct repeatable methods when using websites, and how to make suitable questionnaires.
- Sampling strategy is not just about 'stratified or convenience etc' but about why every aspect of the method is used.
- In APP, realistic suggestions are needed, not just 'post things on social media'.
- When using secondary data, ensure that there is data before embarking on the work.
- For database studies, ensure that students access different sources of data to cross check their work.
- Ensure that students submit a first draft and provide meaningful feedback for improvement.
- Teachers should include comments on the final report explaining how the marks are or are not awarded.
- Ensure that no school or candidate data appear on the IA.
- Do not include an appendix.

Further comments

- Very similar to May 2021
- Word count: reports must be clear and concise and between 1500 and 2250 words (many teachers note this limit). Outside this length will affect the COM mark. Below 1500 words is usually self-limiting with low marks in various criteria.
- For academic integrity, source material must be referenced.
- The report must be anonymous.
- The pandemic has resulted in some 'out of the box' thinking. IAs have been carried out under a much wider variety of conditions than before.

Standard level paper one

General comments

The majority of G2 respondents considered the difficulty of the paper to be appropriate, although 27% believed it was a little more difficult than the previous year and 19% thought it was easier. The quality of the paper in terms of clarity of wording, presentation, readability, suitability and inclusivity was considered to be either acceptable, good or very good by most respondents.

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

Some candidates struggled to understand the requirements of specific command terms. Eg for Q1(b) where the command term was '**outline**', many students **stated** a factor such as 'temperature' that would impact primary productivity. In this case 'temperature' needed to be linked to its influence on photosynthesis for credit.

A significant number of candidates also struggled with the higher order command terms such as '**evaluate**' (e.g. Q4(b) and Q5(b)) and did not address both strengths and weaknesses or provide a balanced conclusion. For Q6 where the command term was '**to what extent**', many candidates did not provide a balanced conclusion.

Specific areas of the syllabus that candidates struggled with included:

- linking primary productivity to photosynthesis (Topic 2.2 Communities and Ecosystems and 2.3 Flows of energy and matter)
- construction of an identification key (Topic 2.5 Investigating Ecosystems)
- understanding various factors that contribute to generation of NOx (Topics 6.3 Photochemical smog and 6.4 Acid deposition)
- understanding the pros and cons of recycling within the management of solid domestic waste (Topic 8.3 Solid domestic waste)
- understanding factors which allow the ecological footprint to exceed biocapacity eg importation of resources (Topic 8.4 Human population carrying capacity)
- understanding factors which would allow human population to increase its carrying capacity (Topic 8.4 Human population carrying capacity).

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

Most candidates were able to interpret data presented in the Resource Booklet correctly (eg Q1(a) and Q1(c)).

Candidates were well prepared for the extended response question (Q6) at the end of the paper. The majority of candidates understood the concept of sustainability and were able to select relevant information from the Resource Booklet as evidence to support their argument in Q6. Most of these responses were well structured and covered both strengths and weaknesses of the sustainability of London.

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

Question 1(a)

The majority of candidates correctly identified an ecosystem found in London.

Question 1(b)

Very few candidates answered this question correctly. Many candidates did not consider the command term used and stated a correct factor eg low temperature or sunlight but did not relate this to its effect on photosynthesis and therefore primary productivity. A few responses incorrectly suggested that high levels of rainfall caused flooding.

Question 1(c)

Most students answered this question well with many responses referring to the green spaces found on the edges of the city.

Question 1(d)

Responses varied widely for this question with most candidates achieving at least one mark. A common error was to repeat statements from Figure 4(b) rather than use this information to consider the goods and services gained from London's green spaces.

Question 2(a)

Most candidates struggled with this question with very few achieving the maximum three marks. Many responses incorrectly used size (of body or antlers), location, breeding rates or diet to differentiate between the deer. A significant number of candidates that did not attempt this question.

Question 2(b)

Many candidates answered this question well with most recognising that the population of deer would increase resulting in overpopulation. Many responses then connected this to overgrazing. Some responses were too vague stating 'instability' or 'collapse of the ecosystem' without indication of the actual changes or why.

Question 3(a)

Many students attempted to give a definition of an ecological footprint or sustainability rather than focusing on a strength and a weakness of using a model in determining EF.

Question 3(b)

Few candidates answered this question correctly. This question was misinterpreted by most students and many responses incorrectly focused on using more local resources.

Question 3(c)

Most candidates achieved some marks for this question with many recognising that vertical farming uses less water, less land area and increases availability of food. Few candidates linked beekeeping to pollination and primary productivity. Some students confused the use of pesticides with fertilizers, incorrectly suggesting pesticides cause eutrophication. There was a significant number of candidates that did not attempt this question.

Question 4(a)

Most candidates achieved at least one mark here for recognising that the high density of transportation in London contributed to the higher levels of NOx. Many responses only provided one or two reasons rather than the three required to achieve the three marks for this question.

Question 4(b)

Most students were able to give an appropriate strategy but in a significant number of responses there was no evaluation.

Question 4(c)

There were some very good responses to this question with many candidates achieving full marks. Common error was to give vague responses eg improves health or reduces disease.

Question 5(a)

There were very mixed responses to this question. A common error was to suggest that due to the high population in London more waste was generated rather than focusing on why the recycling rate was lower.

Question 5(b)

Most candidates achieved at least one mark for this question by recognising that the current rate of recycling was relatively low. Very few students achieved three marks.

Question 6(a)

Most candidates achieved at least two marks for this question by accurately interpreting information in the Resource Booklet that could either contribute to or hinder London being a sustainable city. Responses were generally well structured. However, few students provided a well balanced conclusion. Many conclusions were either one sided or too vague.

Recommendations and guidance for the teaching of future candidates

- Students should be encouraged to read the question carefully and thoroughly. Students should practice reading exam style questions to try and understand what is being asked and then how to answer the question directly.
- Ensure the meaning of each command term is fully understood. It may be useful to practice answering the same question using a different command term to really understand the difference between describe, explain, evaluate etc. Students should also know which command term requires them to include counter arguments and a clear conclusion/appraisal.
- Students should be encouraged to plan and practice six-mark questions, giving arguments for and against in addition to a balanced conclusion. The conclusion requires a value judgement supported by evidence from both sides of the argument.
- Students should be encouraged to consider the number of marks that are awarded to a question and ensure that enough information has been included to earn full marks (eg reasons, impacts, limitations, or examples).
- Students should be encouraged to avoid repetitive points in the same response.
- Students should be encouraged to give focused answers to questions using appropriate ESS terminology. They should avoid using generalised words or phrases such as "pollution/emissions", "impacts/affects" as these are too vague for credit. Responses need to be specific, for example, if pollution is being emitted, what kind of pollution and what is its impact.
- Students should be encouraged to take care with their writing during the exam to ensure that it is clearly legible. Only dark ink should be used as scripts will be scanned and marked on-screen.
- Candidates should be encouraged to keep their answers within the answer box. If extra space is required, then they should continue the response on additional pages.
- Students should practice past papers, answering different command terms, extracting information from data tables, charts and graphs.
- Students should be discouraged from leaving blank responses.
- Ensure the whole syllabus is covered in sufficient detail. This includes ensuring students:
    - understand and are able to construct dichotomous identification keys
    - understand the advantages and disadvantages of using models including for determining the ecological footprint
    - understand how ecological footprint can exceed the biocapacity of an area
    - understand how carrying capacity of an area can be increased.

Standard level paper two

General comments

Overall, the performance of candidates on this paper seemed to indicate the paper was perhaps slightly easier than recent papers (an observation borne out through feedback on the G2s), and although the report below focuses on weaknesses where they were evident, many responses showed considerable competence and ability in the subject.

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

Measuring secondary productivity; calculating Simpson's diversity index; defining species diversity; factors affecting accuracy of Lincoln Index; distinguishing clearly between ozone depletion and global warming; measuring organic pollution in water bodies; examples of ecosystem models; distinguishing mitigation & adaptation strategies.

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

Second law of thermodynamics; processes of evolution; interpreting population data; impacts of DDT; issues surrounding introduced/reintroduced species; role of albedo in maintaining Earth's temperature; contrasting impact of biodiversity loss and climate change; sustainable management of wild fisheries; outlining strategies of water management and food production.

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

Question 1(a)(i)

Very well answered.

Question 1(a)(ii)

Great majority were unable to identify how gross secondary productivity is measured.

Question 1(a)(iii)

Many were able to suggest some appropriate application of the second law of thermodynamics to a food chain.

Question 1(b)

Generally well answered.

Question 1(c)

Majority were at least able to begin explaining the process of natural selection in this context.

Question 2(a)

Some were able to correctly calculate the diversity index, though a large number failed to attempt this question.

Question 2(b)

Few were able to give a precise definition of species diversity.

Question 2(c)

Most were able to suggest one reason why diversity increases in succession but few were able to gain full credit.

Question 2(d)(i)

Good number recognised Lincoln index as an appropriate method.

Question 2(d)(ii)

Few were able to identify factors affecting the accuracy of the method.

Question 3(a)(i)

Very well answered.

Question 3(a)(ii)

Majority were able to identify one reason for uncertainty in population projections.

Question 3(b)(i)

Majority were able to identify the relevant region.

Question 3(b)(ii)

Majority were able to suggest valid reasons for reduction in population.

Question 3(c)

Many were able to gain some credit in explaining link between DTM and population policies but few were able to gain full credit.

Question 4(a)

Majority were able to identify one or two controversial aspects of DDT although few gained full credit.

Question 4(b)

Majority were able to link stratospheric ozone and ozone depleting substances like CFC but frequently answers were confused with aspects of greenhouse gases and global warming.

Question 4(c)

Majority of answers were completely valid but rarely did they explore the question with sufficient breadth.

Question 5(a)

Not many responses went beyond measuring oxygen as an indication of organic water pollution. Most responses had no practical details of procedure.

Question 5(b)

Great majority of candidates were unable to identify examples of ecosystem models (food chains/pyramids/flow charts/aquaria/indices/computer models, etc) so answers were very vague.

Question 5(c)

Candidates appeared very familiar with issues of introduced species but had little to add when it came to issue of reintroduction.

Question 6(a)

Most candidates had some valid idea of albedo and its role in temperature regulation.

Question 6(b)

A large proportion of candidates mistook mitigation strategies for adaptation and so failed to gain significant credit.

Question 6(c)

Generally well answered, although weaker candidates failed to explore the full scope of the question.

Question 7(a)

Most candidates were able to identify several strategies for sustainable management of wild fisheries, although a few mistakenly addressed aquacultural systems.

Question 7(b)

Majority of candidates were able to describe two water management strategies but often failed to evaluate their sustainability in any detail.

Question 7(c)

Characterisation of value systems tended to be simplistic/inaccurate particularly in the distinctive features of anthropocentrism. However, a good range of food production strategies was offered.

Recommendations and guidance for the teaching of future candidates

Aside from addressing the curriculum issues and topics indicated above, some attention could be paid to exploring the full breadth of potential answers particularly the part (c) questions in Section B. Candidates need to practice brainstorming as many possible valid points from a wide range of the syllabus, and then organising them into a balanced and rational argument.

The issue of confusion over ozone depletion and global warming is still very much prevalent in responses and needs some direct and persistent focus in teaching.