Course report 2022

Subject	Environmental Science
Level	Higher

This report provides information on candidates' performance. Teachers, lecturers and assessors may find it useful when preparing candidates for future assessment. The report 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 assessment documents and marking instructions.

The statistics used in this report have been compiled before the completion of any appeals.

Grade boundary and statistical information

Statistical information: update on courses

Number of resulted entries in 2022	545

Statistical information: performance of candidates

Distribution of course awards including grade boundaries

A	Percentage	20.2	Cumulative percentage	20.1	Number of candidates	110	Minimum mark required	74
B	Percentage	22.0	Cumulative percentage	42.2	Number of candidates	120	Minimum mark required	60
C	Percentage	27.2	Cumulative percentage	69.4	Number of candidates	145	Minimum mark required	46
D	Percentage	19.7	Cumulative percentage	89.1	Number of candidates	110	Minimum mark required	32
No award	Percentage	10.9	Cumulative percentage	N/A	Number of candidates	60	Minimum mark required	N/A

You can read the general commentary on grade boundaries in appendix 1 of this report.

In this report:

- ‘most’ means greater than 70%
- ‘many’ means 50% to 69%
- ‘some’ means 25% to 49%
- ‘a few’ means less than 25%

You can find more statistical reports on the statistics page of SQA’s website.

Section 1: comments on the assessment

Feedback from the marking team, teachers and lecturers, and their candidates, indicated both papers were positively received by centres and were fair and accessible for candidates.

Question paper 1

Question paper 1 focuses on an application of environmental science and has an intentional emphasis on problem solving. Most candidates performed strongly in this paper, especially in the final decision-making question.

The use of the term ‘green’ fuel source in question 1(a)(ii) appeared to confuse some candidates.

Question paper 2

Question paper 2 followed the same format as question papers in previous exams. Literacy skills, and understanding of command words and scientific terms, were noticeably poorer in this paper than in paper 1, while numeracy skills performance continues to be variable, and a notable number of candidates did not attempt calculations.

Advance notice of essay topics was provided this session, and this proved to be beneficial for candidates. Despite this, a few candidates either did not attempt any essays or were awarded no marks for their responses. Candidate performance in the paired options in the essay questions was similar to that of previous years.

It was noticeable that many candidates submitted incomplete question papers, particularly paper 2. While incomplete submissions are not uncommon, the number and pattern of non-responses suggest significant knowledge gaps to be an issue, rather than a time issue.

Markers noted that many candidates missed marks due to poor literacy skills; poor knowledge and understanding of scientific terms; and use of low-level language not commensurate with Higher. Familiarity with command words also continues to be an issue.

Some questions proved to be more demanding than intended, including question 1(d)(iii), question 3(b)(iii), parts of question 5, and question 6(b).

Assignment

The requirement to complete the assignment was removed for session 2021–22.

Section 2: comments on candidate performance

The following information highlights how candidates performed in the question papers.

Question paper 1

Question 1(a)(i)	Naming a landfill gas that enhances the greenhouse effect. Most candidates were able to name an appropriate gas.
Question 1(a)(ii)	Suggesting why landfill gas could be considered to be a 'green' fuel source. Some candidates were able to suggest a valid reason. However, responses suggest that many candidates might have been confused by the term 'green'.
Question 1(b)(i)	Suggesting an impact that mineral-rich ash waste would have on soil. Many candidates showed an acceptable level of understanding of the contribution mineral-rich ash waste would make to soil.
Question 1(b)(ii)	Suggesting why a high level of biodiversity can be found in the area. Many candidates used the evidence from the supporting information successfully, to suggest why a high level of biodiversity was present.
Question 2	Suggesting which of the two options presented would be most able to withstand the impacts of rising sea level. Many candidates used information from the supporting information to support their justification for why Option 1 would be most able to withstand the impacts of rising sea level.
Question 3(a)	Identifying the type of random sampling used in the opinion poll. Some candidates recognised that stratified (random) sampling was used.
Question 3(b)	Calculating the total projected ticket revenue generated in one day during peak periods. Many candidates were able to calculate the projected ticket revenue correctly.
Question 3(c)	Calculating the interquartile range (IQR). Few candidates were able to calculate the IQR correctly. Candidates showed an overall poor understanding of the method for calculating IQR. While most knew to identify Q_1 and Q_3 and were awarded one mark, some were either unsure about calculating the range or stated an incorrect response.
Question 3(d)	Explaining why offering combined travel and entry tickets may have a negative environmental impact. Most candidates provided a valid negative impact. However, responses often lacked sufficient detail of how this would impact specifically on the environment for the second mark to be awarded.

Question 4	Explaining a possible environmental impact of the method used for managing construction materials. Most candidates successfully named and explained a potential environmental impact.
Question 5	Suggesting why the forecasted job creation might be misleading. Many candidates provided valid suggestions.
Question 6	Deciding which of the options should be adopted, with justification. Candidates performed well in the decision-making task, bringing together evidence from the supplementary booklet, the question paper, and their own knowledge, to justify their chosen option. Many demonstrated logical reasoning and achieved high marks, but some candidates provided only bullet points and/or little justification.

Question paper 2

Question 1(a)	Stating the purpose of the waste hierarchy. Few candidates were able to state the purpose of the waste hierarchy model, with most suggesting it is what is best for the business, rather than best for the environment.
Question 1(b)	Describing two environmental impacts of incineration, without energy recovery. Most candidates described one valid impact of waste incineration on the environment. Some candidates could describe two impacts.
Question 1(c)(i)	Describing an advantage and a disadvantage of use-by date labels. Most candidates gave a valid advantage and disadvantage of food product labelling.
Question 1(c)(ii)	Calculating tonnage of food and drink waste. Many candidates calculated the tonnage incorrectly or did not attempt the question. Of those who calculated the correct result, some included an incorrect unit (frequently stating either ‘million’ or ‘tonnes’, rather than ‘million tonnes’).
Question 1(d)(i)	Describing two benefits of packaging. Most candidates demonstrated a good understanding of the benefits of packaging.
Question 1(d)(ii)	Naming the type of economic model described. Some candidates were able to name the linear economic model, although many incorrectly stated the circular economic model. Responses suggest a notable number of candidates were unfamiliar with either of the economic models stated in the course specification.

Question 1(d)(iii)	Describing differences between open and closed loop recycling. Candidates showed an overall poor understanding of open and closed loop recycling, with most unable to adequately describe even one difference between these.
Question 1(d)(iv)	Suggesting how juice could be packaged more sustainably. Many candidates were able to suggest how the juice could be packaged more sustainably. A wide range of reasonable suggestions for sustainable packaging for juice was accepted. However, some suggestions were clearly improbable and demonstrated poor logic.
Question 2(a)(i)	Defining genetic diversity. Some candidates provided an acceptable definition, but many did not include the essential points of the term.
Question 2(a)(ii)	Explaining why habitat fragmentation may cause a decrease in genetic diversity. Many candidates provided a reasonable explanation of how bear populations could be split by habitat fragmentation, but some omitted how this would impact on genetic diversity over time.
Question 2(a)(iii)	Describing two environmental impacts of motorway construction. Most candidates were able to describe at least one valid environmental impact of the construction of motorways, and many could describe two.
Question 2(b), (c)(ii)	Explaining why the results of the study could be considered reliable and explaining why the use of three techniques would increase validity. Candidates demonstrated poor understanding of reliability and validity. Few could explain satisfactorily why the results of the study could be considered reliable but fared better with explaining why using three techniques would increase the validity of the study.
Question 2(c)(i)	Suggesting why hair sampling was determined to be the better technique. Many candidates provided valid reasons for why hair sampling was the better technique in this instance.
Question 3(a)	Naming the environmental agency with responsibility for monitoring the quality of Scotland's bathing waters. Some candidates knew that the Scottish Environment Protection Agency (SEPA) has this responsibility. The remainder either gave an incorrect response or did not attempt the question.

Question 3(b)(i) Identifying the population growth model demonstrated by *E. coli* in the graph.
Few candidates identified logistic growth for *E. coli* from the trend shown in the graph. Most either gave an incorrect response or did not attempt the question.

Question 3(b)(ii) Describing the apparent relationship between the concentration of intestinal *enterococci* and total precipitation.
Many candidates provided acceptable descriptions of the apparent relationship between intestinal *enterococci* and precipitation depicted in the graphs. However, a few demonstrated poor logic by incorrectly stating that the concentration of intestinal *enterococci* affects the total precipitation, rather than vice versa.

Question 3(b)(iii) Explaining why bacterial contamination at Kinghorn Harbour Beach can be an example of both point and diffuse pollution.
Few candidates provided a satisfactory understanding of point and diffuse pollution and the difference between them. Most either gave an incorrect response(s) or did not attempt the question.
It is clear that candidates struggled with differentiating between the two types of pollution in this example.

Question 3(b)(iv) Suggesting why swimming should not take place at Kinghorn Harbour Beach after periods of heavy rainfall.
This question required candidates to link heavy rainfall with a pollutant harmful to human health. Many candidates named a valid pollutant that could harm humans at a beach, but few factored heavy rainfall into their response.

Question 3(b)(v) Suggesting another pollutant that may be present at Kinghorn Harbour Beach.
Many candidates were able to name a pollutant that may be present at the beach, with a wide range of agricultural, urban, beach, and marine-related responses accepted.

Question 3(c)(i), (ii) Explaining how algal blooms form and how they could be reduced in future.
Few candidates were able to explain how algal blooms form. Many instead described the impacts of eutrophication, while citing pesticides as a causative agent was a common error.
In contrast, some candidates provided valid descriptions of how the occurrence of algal blooms could be reduced.

Question 4(a) Describing the purpose of environmental monitoring.
Few candidates described satisfactorily the purpose of environmental monitoring. Most thought a single assessment constitutes monitoring, rather than repeated assessments to identify change over time.

Question 4(b)(i) Calculating the number of juvenile female owls hatching by the end of the year.
Many candidates calculated the correct value.

Question 4(b)(ii) Calculating an estimate for the total number of female owls present in patch A by the end of the year.
Some candidates calculated a correct value. Many either substituted incorrect values into the formula or made an error in totalling.

Question 4(b)(iii) Stating whether the carrying capacity had been exceeded, with justification.
Many candidates concluded correctly whether the carrying capacity of the habitat patch had been exceeded, using their calculated value from part (ii) along with information provided in the question stem. Credit was given where an incorrect value was carried forward from question 4(b)(ii) and the candidate provided appropriate justification for whether the carrying capacity of the habitat patch had been exceeded **based on their calculated value**.

Question 4(b)(iv) Suggesting why the model is not truly representative of the northern spotted owl population.
Many candidates were able to reason why the model used was not truly representative of this owl species.

Question 4(c) Explaining population oscillations around the carrying capacity.
Few candidates were able to explain why populations oscillate around the carrying capacity. Most candidates appear to have been unfamiliar with one or both terms and consequently were unable to make a link between resource availability and population response.

Question 4(d) Suggesting a rewilding activity that could improve the health of an old-growth forest ecosystem.
Many candidates provided either an inappropriate rewilding activity or failed to consider how their suggested activity would improve the old-growth forest ecosystem specifically. For example, ‘reintroduction of wolves to control browsers/deer’ would benefit re-growth of trees, whereas ‘reintroduction of wolves’ without further discussion would be insufficient for the mark to be awarded.

Question 5(a)(i), (ii), (b) Describing how differences in temperature cause the circulation of ocean currents; explaining why upwelling is essential for supporting marine food webs; and explaining why a release of freshwater would have disrupted the global conveyor belt.
Few candidates demonstrated a good understanding of these key areas, with most either not achieving marks or not attempting the questions.

Question 5(c)(i) Naming the process used for converting saltwater into drinking water.
Many candidates were able to name the desalination process.

Question 5(c)(ii)	Stating a factor that could contribute to water insecurity. Many candidates stated an appropriate factor.
Question 6(a)	Identifying the appropriate pH range. Most candidates identified the correct pH range from the kite diagram.
Question 6(b)	Explaining, using a named nutrient, why strongly acidic soils are generally not suitable for agriculture. Candidates were instructed to use information from both the kite diagram and the table. However, most extracted statements from the table only and did not make a connection with pH, and/or did not discuss the impact on agriculture (that is the impact on agricultural yield).
Question 6(c)(i)	Recognising the definition of an edaphic factor. Most candidates did not recognise the definition.
Question 6(c)(ii)	Describing a hydrological impact of compaction on topsoil. Many candidates recognised that compaction of topsoil would impede water movement, but few provided sufficient detail to be awarded both marks.
Question 6(c)(iii)	Explaining how compaction would affect the presence of soil bacteria. Few candidates were able to explain how loss of air channels in soil, due to compaction, would result in either a reduction in aerobic bacteria or increase in anaerobic bacteria.
Question 7(a)(i)	Completing the graph. Graph production was well done overall, with many candidates achieving both marks. A few candidates did not read the question properly and drew a line graph.
Question 7(a)(ii)	Describing the trends shown in the graph. A few candidates described both trends successfully, including providing appropriate values. Many candidates did not achieve either of the marks available, due to their responses being either incorrect or poorly worded.
Question 7(b)(i)	Recognising the definition of evapotranspiration. Some candidates recognised the definition, many stated transpiration (which does not include evaporation from the land surface) or gave another incorrect response.
Question 7(b)(ii)	Stating a type of natural water storage. Most candidates named a valid type of natural water storage.

Question 7(b)(iii) Suggesting why the use of deep wells would support only local crop production.
Some candidates provided a valid suggestion for why use of deep wells would support only local crop production.

Question 7(c)(i) Calculating percentage change.
Some candidates calculated the correct value. Incorrect transcription of the calculator value was fairly common, for example 1210% or 1220% rather than 1120%.
A few candidates incorrectly included reference to hectares in their final answer, for example 1120% ha^{-1}.

Question 7(c)(ii) Calculating the volume of water needed for cotton irrigation.
Few candidates calculated the correct value.
The question asked for the value to be stated to the nearest million cubic metres, but some candidates gave an unrounded value and/or used incorrect units, for example, m^3 ha^{-1} instead of m^3.

Question 7(d)(i), (ii), (iii) Naming the salination process; explaining why soil salinity increases during summer months; and suggesting a change in practice to reduce the increasing salinity of the Harran Plain.
Responses suggest that few candidates were familiar with the process of capillary action.
Some candidates were able to determine from the table/graph that increasing soil salinity during the summer months must be linked to high temperatures and low precipitation, but were subsequently unable to explain why.
Some candidates could suggest a change in practice to reduce the increasing soil salinity.

Question 8(a), (b)(i), (ii) Naming the type of plate boundaries and explaining why oceanic plate moves below continental plate.
Most candidates were familiar with the subduction process and plate movement mechanisms, though frequently did not refer to density in their response to (b)(ii).

Question 8(c)(i), (ii), (d) Describing the formation of extrusive rock; stating why volcanoes at subduction zones can be very explosive; and explaining why earthquakes at subduction zones can be of very high magnitude.
Most candidates demonstrated poor general understanding of volcanism, including the difference between magma and lava.

Essays A few candidates did not attempt either one or both essays, despite having advance notice of the topics.
A poor standard of literacy and/or knowledge commensurate with Higher was especially noticeable in responses.
Use of bullet points was common, and a few candidates did not gain marks due to providing lists, such as simply naming steps in sewage treatment and then not discussing each step.

	There was evidence of some candidates having had access to model answers to learn in preparation for the exam, some of which appear to have included incorrect details and/or use of lower-level terms and language not commensurate with Higher.
Question 9	The number of candidates choosing option A was similar to option B. The number of candidates achieving five or more marks was similar for both options, but more candidates achieved eight or more marks for option A (sewage treatment) than for option B (fracking).
Question 10	An equal number of candidates selected option A and option B. The number of candidates achieving five or more marks was similar for both options, but slightly more candidates achieved eight or more marks for option A (redistribution of solar energy) than for option B (bauxite mining and processing).
Question 10A	Some candidates achieved high marks through use of detailed diagrams with accompanying annotations and/or discussion. Many candidates provided good coverage of the tricellular model, but few included discussion of surface winds or the Coriolis effect.
Question 10B	A notable number of responses included irrelevant discussion of bauxite formation.

Section 3: preparing candidates for future assessment

Centres should ensure that candidates are provided with a copy of the mandatory content tables and glossary available in the Higher Environmental Science Course Specification. These will enable candidates to familiarise themselves with phrasing and terminology used at Higher, plus the section headings and sub-headings in the first column are often included in question stems and extended-response questions.

Past papers and marking instructions are a useful resource to show candidates the expected level and depth of response required. Centres should encourage candidates to practise past paper questions.

Candidates **must** be given the opportunity to take an active part in a wide range of practical work and fieldwork, to develop the necessary knowledge and skills. This will help candidates with questions that ask about practical or fieldwork contexts. While demonstration of experiments, videos, and computer simulations may be useful additional tools, they cannot replace active practical or fieldwork and do not develop the knowledge and skills associated with these.

The areas where gaps in candidate knowledge and understanding were especially noticeable include:

- Definitions
- Calculations
- Describing trend(s) shown in a graph
- Living environment
- Earth's resources:
  - oceanic circulation (thermohaline circulation, upwelling)
  - soil formation (capillary action) and composition (movement of air and water)
  - destructive plate boundaries (volcanism, formation of extrusive rock)
- Sustainability:
  - waste hierarchy model (purpose, types of economic model, open and closed loop recycling)
  - formation of algal blooms

Teachers and lecturers should highlight these areas to candidates and encourage them to develop the appropriate knowledge and skills.

Teachers and lecturers are encouraged to incorporate the command words used in exam questions into teaching at an early stage, especially the difference between 'describe' and 'explain', and 'conclude' and 'evaluate'. 'Suggest' is commonly used in Higher Environmental Science question papers, allowing candidates to apply their knowledge and understanding in familiar and unfamiliar contexts.

Integration of key areas from across the course is a key feature of Environmental Science questions, and some candidates find this challenging. It is also important that the

environmental, economic, and social impacts of human actions, and relationships between them, are considered. Candidates should be encouraged to explore the interconnections between topic areas and identify the benefits and challenges that might ensue, for example global demand for food versus food security versus environmental impacts of intensive agriculture.

Candidates should be encouraged to write as clearly as possible, and to write in full sentences rather than brief statements or phrases. Use of bullet points should be discouraged unless fuller discussion of each point is also included.

Candidates should be encouraged to attempt calculations and graphing questions. Many of the calculations are not especially challenging, perhaps involving large values or simple number substitution, but the number not attempting them suggests some candidates are reluctant to spend time on them. Candidates should be encouraged to show working in calculations, especially calculations with multiple stages and marks. Showing working can be beneficial for the candidate if their final result is incorrect.

Where a unit is included in a question stem, there is no requirement for candidates to state it alongside their calculated result. However, at Higher, it is good practice to do this — but care should be taken to ensure it is expressed correctly.

Appendix 1: general commentary on grade boundaries

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

For most National Courses, SQA aims to set examinations and other external assessments and create marking instructions that allow:

- a competent candidate to score a minimum of 50% of the available marks (the notional grade C boundary)
- a well-prepared, very competent candidate to score at least 70% of the available marks (the notional grade A boundary)

It is very challenging to get the standard on target every year, in every subject at every level. Therefore, SQA holds a grade boundary meeting for each course to bring together all the information available (statistical and qualitative) and to make final decisions on grade boundaries based on this information. Members of SQA's Executive Management Team normally chair these meetings.

Principal assessors utilise their subject expertise to evaluate the performance of the assessment and propose suitable grade boundaries based on the full range of evidence. SQA can adjust the grade boundaries as a result of the discussion at these meetings. This allows the pass rate to be unaffected in circumstances where there is evidence that the question paper or other assessment has been more, or less, difficult than usual.

- The grade boundaries can be adjusted downwards if there is evidence that the question paper or other assessment has been more difficult than usual.
- The grade boundaries can be adjusted upwards if there is evidence that the question paper or other assessment has been less difficult than usual.
- Where levels of difficulty are comparable to previous years, similar grade boundaries are maintained.

Grade boundaries from question papers in the same subject at the same level tend to be marginally different year on year. This is because the specific questions, and the mix of questions, are different and this has an impact on candidate performance.

This year, a package of support measures including assessment modifications and revision support, was introduced to support candidates as they returned to formal national exams and other forms of external assessment. This was designed to address the ongoing disruption to learning and teaching that young people have experienced as a result of the COVID-19 pandemic. In addition, SQA adopted a more generous approach to grading for National 5, Higher and Advanced Higher courses than it would do in a normal exam year, to help ensure fairness for candidates while maintaining standards. This is in recognition of the fact that those preparing for and sitting exams have done so in very different circumstances from those who sat exams in 2019.

The key difference this year is that decisions about where the grade boundaries have been set have also been influenced, where necessary and where appropriate, by the unique circumstances in 2022. On a course-by-course basis, SQA has determined grade boundaries in a way that is fair to candidates, taking into account how the assessment (exams and coursework) has functioned and the impact of assessment modifications and revision support.

The grade boundaries used in 2022 relate to the specific experience of this year's cohort and should not be used by centres if these assessments are used in the future for exam preparation.

For full details of the approach please refer to the National Qualifications 2022 Awarding — Methodology Report.