Questions matter

A-level
Environmental Science

7447/1 Paper 1

Report on the Examination

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Overview

This year there was an increase in the total student numbers taking Environmental Science and the standard of responses continues to improve. The students performed at a similar level to 2023 but the mean was a marginal improvement, and it was good to see an increasing range in the number of marks achieved. On the whole the students performed better on this paper compared to Paper 2. Students found questions requiring explanations or extended writing accessible. It was also pleasing to see many more students attempting and scoring on questions requiring mathematical skills and data processing. It was evident that students are familiar with environmental terminology; however cases of poor expression limited the performance of some. This was particularly evident in short answer questions. The continued use of question framing, eg explain two, allows students to structure their answers appropriately.

It was pleasing to see students attempt practical questions and show a depth in understanding. While some topics eg nitrate testing proved a challenge, the use of the Tüllgren Funnel was well understood. It was also pleasing to see that students applied their knowledge of sampling to specific situations. Generally, the mathematical components in the paper were well attempted. Students coped well with numerical transformations and also showed an ability to complete staged calculations in working out components of the USLE equation. It has been pleasing to see the improvement in student performance over the past 3 years on mathematical items, including by picking up marks for error carried forward when showing their calculations. We encourage this. Students also showed ability in data analysis questions and could offer trends and anomalies.

Levels of response questions were the best at discriminating students on the paper. There were some excellent examples of students' planning and clear attempts to provide a structure to the 25-mark essay questions, especially when the question had multiple parts. Despite the improvement we would suggest centres encourage students to include specific terminology and offer explanations which refer to scientific understanding. In some cases, answers remain too generic. We also encourage centres to focus their essay practice on the working of the Level of Response mark scheme rather than the indicative content. We were, however, pleased to see focus on the command words and this was evident in 10.3 where the top scoring students effectively evaluated their response.

Timing is always critical on this paper. It was evident that some students did not manage their time. Students are encouraged, where possible, to attempt higher tariff questions earlier in the examination so that they maximise their chances of accumulating marks.

It was great to see a continued student improvement on this paper, which is a reflection of the hard work centres undertake to prepare their students.

Question 1

Question 01.1

This question was a challenge to many students and a good discriminator. Many scored catalytic convertor for carbon monoxide technology and NOx for urea spray. Fewer scored CFC for flue gas desulfurization and methane for the recovery of gas from coal mines. Many understood a technology for PM10. Around 4% of students scored full marks and a more than 10% scored 4 out of 5.

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Question 2

Question 02.1

With around 70% of students achieving one mark or more it was clear that the interpretation of cumulative graphs to give reasons for increased renewable use proved a challenge. Although the command was 'suggest' we encourage students to avoid generalisations eg 'cheaper' or 'more technology'. Common correct answers included increased efficiency of renewable technologies, or increased awareness of the negative impact of fossil fuels or climate change. Many wrote about finite fossil fuels, but this was not credited.

Question 02.2

Over 65% of students scored the correct answer of 34.9 and showed their working, which was excellent. However, those scoring 1 mark often confused the conversion of units TWh to GWh. Some students correctly worked out their answer but were limited by not giving 3 significant figures. One example of this is when students gave 0.035, not realising that the zeros are not significant.

Question 02.3

With over 80% of students scoring credit there was good understanding of the advantages of VAWTs over HAWTs. Common correct answers included 'generating from any wind direction' and an 'ability to operate at lower velocities'. However, as with many comparative questions, students were sometimes limited by their expression eg cheaper. They needed to consider what specifically is cheaper.

Question 02.4

This question provided a challenge and discriminated well. A significant minority (<5%) of students left a blank response indicating a lack of understanding. Common correct answers included HEP for gravitational potential energy or molten salt for heat energy. Often students could name a technology but struggled to explain how the energy was stored. The incorrect responses contained references to carbon capture and solar panels. Over 20% of students scored zero and so alternative storage methods is an area of focus for centres.

Question 3

Question 03.1

Generally, a well answered question with over half of students scoring 3 marks or more. Students needed to link the factor to which site had more erosion. Good students linked process and outcome, for example site 1 has increased gradient so more erosion due to surface runoff. However, a significant minority of students were limited by not specifying which site had more erosion. Some students just listed factors eg site 1 has increased gradient and interception and less disturbance, without clearly linking them together. Some answers referred to agriculture and residential areas which were not geographically close to either site, suggesting students needed to use the map scale.

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Question 03.2

Over three quarters of students scored 2 marks for correctly calculating the missing parts of the USLE. The vast majority of students scored at least one mark here, with very few not achieving a mark.

Question 03.3

Calculating the LS and K factors over time provided a much greater challenge than question 3.2 with students needing to understand percentage change and cumulative parentage changes over time. Many students (over 75%) scored 1 mark, often for the calculation of LS factor. Calculating the K factor was more challenging, though around 60% of student managed this. However, the third mark was available for the correct calculation of the K factor and around 20% of those who calculated the correct answer showed incorrect or no working. Students needed to show steps in their calculations to show temporal change in percentage. A common mistake was when students gave 15% of the original K factor. Some students also lost marks for not giving 2 significant figures, despite this being specified.

Question 03.4

This question provided one of the greatest challenges on the paper, with approximately 70% of students not scoring a mark. Fortunately, it was only worth one mark! Many did not understand the concept of crop management practice. Those that did understand often still failed to gain credit if they did not link it to reducing the C factor. However, good answers focused on multi-cropping and the root binding to reduce the C factor.

Question 4

Question 04.1

A well answered question with around 80% of students scoring the mark, interpreting the logarithmic graph correctly. Some students did misinterpret the logarithmic scale and gave answers outside the accepted range of 65-67, but almost all students attempted this question.

Question 04.2

Many students scored a mark and understood how abiotic factors changed noise levels from a railway. The most common answer was trees / vegetation absorbing noise. Those that did not score the mark often mentioned the factor without saying how it reduced the noise, eg absorbed, deflected.

Question 04.3

This question produced a variety of answers though around 40% of students scored at least one mark. Most common correct answers were wheel noise reduction measures such as track / wheel lubrication, or engine noise reduction using electric trains. Some students were not specific on how noise was reduced eg materials to reduce squeaky brakes. Many referred to baffle mounds which were not relevant. Some described lubricating brakes which, in reality, is not a great idea.

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Question 04.4

Students are familiar with these questions on variables and hence 90% scored up to 2 marks. Common answers included 'same distance between box and speaker', 'same microphone' or 'calibrated sound meter'. Some mentioned irrelevant factors in this context like time of year or a soundproof room. Some students lost marks for saying 'type of noise' but needed to specify volume.

Question 04.5

Questions linked to statistics seem to always provide a challenge and this was no different. Only half of students selected the correct method for correlation. There was often confusion between Mann Whitney and Spearman's. It was good to see some students give the answer 'Pearson's'.

Question 04.6

This was another challenging statistics question with just less than 50% of students scoring the correct response. Common mistakes included giving 0.05 or the critical value in the table rather than the p-value. Centres are advised to continue to practise statistical significance, although with each cohort there are improvements!

Question 5

Question 05.1

Understanding of nitrate testing proved to be a challenge with some students leaving it blank and many scoring 0. The most common correct answer was 'nitrate test strips' and 'comparison to colour'. Some referred to colour change from test strips but did not make the link to the colour chart. There were many answers which confused this with measuring pH.

Question 05.2

The two elements to this question were the description of the sampling and the application over time. Many students focused on one or the other; hence around 40% of students scored 1 mark. As this question was situational, students needed to be specific in their description, for example sampling each month rather than saying at points 'throughout the year'.

Question 05.3

Students made a good attempt at this question with just less than 30% scoring two marks for the correct answer 51,000,000. However, many students read the graph ignoring the scale, or did not round their answers to 2 significant figures. A common mistake was where students divided 5200 million by 70 years but did not subtract 22,857,143.

Question 05.4

Like most 4-mark items on the paper this question discriminated well, with over 40% of students scoring 3 or above and only around 15% scoring full marks. Many gained credit for a disadvantage linked to eutrophication. However, some were limited by not linking eutrophication to deoxygenation or its impact on aquatic organisms. Students found the advantages more challenging to gain credit on. Some

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recognised higher yield but could not link this to increased growth rate of plants or greater productivity. Confusion between pesticides and fertilisers was common in a significant minority of answers.

Question 6

Question 06.1

A mix of responses here as students either got full marks or focused on mean temperature change rather than uncertainty. Many recognised the higher rates of uncertainty in the 'proxy data' period and lower rates during the 'observed period'. Some recognised the elimination of uncertainty after 1970 but failed to achieve the mark due to giving an incorrect date, meaning they struggled to interpret the scale on the graph.

Question 06.2

With only a small proportion scoring full marks, many students struggled to offer a reason why proxy data had accuracy issues. Good answers referred to the inaccuracies of a specific proxy data, eg dendrochronology or the limitations of locational variation in the data.

Question 06.3

A lack of specificity limited students' responses on why scientists could struggle with future climate change predictions. Common incorrect answers included a lack of understanding of physical processes without stating what or how. High scoring students often referred to difficulty in implementing the Paris agreement or the delay between cause and effect.

Question 06.4

This was another question which discriminated well, however despite over 50% of students scoring 2 marks, very few scored full marks. Many students scored some marks on ocean acidification and recognised the cause of CO_2 in the atmosphere or increased CO_2 sequestration. However, fewer linked this to increased carbonic acid in the ocean. The forest fire part was accessible, but many answers lacked specificity, eg saying 'hotter conditions' rather than drought. Many students struggled to identify the causes of the fire – eg saying the 'forest had dried out' rather than 'drier litter leads to increased combustibility'.

Question 7

Question 07.1

With over 70% of students scoring a mark many understood the Tüllgren Funnel method. Common mistakes included references to the soil falling through the perforated mesh. Some students were limited by not fully explaining the process, eg organisms move downward, without linking this to light sensitivity. Only around 20% of students scored full marks and commonly they did not answer how the method can be used to investigate the organisms eg counting or identification of species.

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Question 07.2

Most students scored at least one mark but only around 35% scored full marks. Students were limited by an inability to link fully the role of the organism to the increased fertility. Common correct responses included the 'breaking down organic matter by an organism, releasing nutrients into the soil' or the role of nitrifying bacteria in nitrogen fixation.

Question 8

Question 08.1

This was a multiple-choice question requiring the calculation of area. For one mark this was a challenge, and many students found this area calculation difficult with only around a third of students giving the correct answer.

Question 08.2

Most students scored a mark for the correct named technology. Some were let down by lack of specificity eg drilling, or references to sonar. It was good to see students applying their understanding of different methods.

Question 08.3

Students gave a good range of answers with around a fifth getting full marks and approximately 60% scoring at least 2 marks. The geological concepts can sometimes provide challenge, but this question showed a good understanding of process. Common mistakes included not linking directly to water and just linking to magmatic processes. Higher scoring students made clear links to the heat source, the heating of water, the movement along fissures, cooling and precipitation and order of solubility. Overall, this was generally well understood.

Question 08.4

This was an accessible question with three quarters of students scoring at least two marks. Students who used the figure to recognise the faults or the relative depth of the deposit could explain in the context of why it was more viable. As the concept of viability was given in the question, we did not accept references to economic reasons which limited some students. Other common incorrect responses included references to the igneous intrusions which were not part of the hydrothermal deposit. Some students needed to explore exactly how mining would be 'easier' rather than generalising.

Question 9

Question 09.1

With around 75% of students scoring 2 marks students found this question accessible. Common incorrect answers for sources of radiation were 'air' or 'animals'.

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Question 09.2

Over half of students correctly calculated 1/32 as the correct answer. Some made mistakes in the calculation of half-life, which could have been addressed through careful checking.

Question 09.3

A few mistakes crept into students' responses and fewer than 20% scored full marks, though many did gain 2 marks. Common correct responses included age, sex and species. Some students failed to apply their answers to this context and therefore irrelevant standard answers like 'same time of day' or same 'location' were not relevant.

Question 09.4

Students attempted this data analysis question well with near 60% scoring 2 marks. Many scored at least one mark for recognising the negative relationship / correlation or describing it. Many did not use data points to support their statements, which was a mark. However, the data point could only be awarded if specific values for both WBC and caesium were given. Good answers recognised the weak correlation or variability within the correlation. It was good to see only a small number of students simply describing the data showing that analysis is a well-practiced skill.

Question 10

Question 10.1

Students found the command 'evaluate' linked to a trend a challenge and hence less than 15% scored full marks. Many only addressed one side of the statement and were limited to 2 marks. Some simply described the data without directly engaging with the evaluation command and only scored 1 mark. Higher scoring students presented both sides and supported this with data. However, a significant minority just described their response without data, despite the specific request for it.

Question 10.2

Another question linked to statistical methods which proved to be a challenge, with very few students scoring full marks and around a quarter scoring 2 marks. As with question 4.5, students found it difficult to apply the appropriate statistical technique to a situation. Common incorrect answers included Spearman's or Chi-Squared. Mann Whitney U-test test was accepted but the follow up reasoning had to be relevant to the use of this test eg median differences. Only around 60% of students scored a mark for the named test. Those who gave T-test as the correct answer often had enough understanding of statistics to score at least one of the remaining two marks. Again, practice calculating and applying statistics to situations would benefit future students.

Question 10.3

This question on methods to manage ozone depletion was fairly well understood and discriminated well. With a mean mark of 4.2, many students offered at least one appropriate method and a significant number engaged with the command 'evaluate'. Lower scoring students confused ozone depletion methods with managing CO_2, referring to the Paris or Kyoto agreements or afforestation. Lower scoring students in Level 1 tended to be overly descriptive or list a range of methods, most commonly banning

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CFCs. Range and depth were the key to progress through the levels. Students in Level 2 could offer some explanation or simple evaluation of the named method. Common approaches included recognising the alternatives to CFC eg CFCs were reduced through the Montreal Protocol and replaced by HCFCs, yet these have been phased out due to the damage they cause to the ozone layer. Higher scoring students offered a range of responses and were either evaluative after each point or provided a meaningful summative evaluative comment.

Question 11

Question 11.1

This question was less popular than 11.2 but often produced greater focus on the dispersal and severity factors than answers for 11.2. Despite this, students achieved a remarkably similar mark distribution on both essays, almost 10% of students achieving Level 5 responses; an improvement on previous cohorts. The mean mark on 11.1 was 13.5 while it was 13.8 on 11.2 underlining the similarity of responses. This was evidence that there was high comparability across the essay questions.
Higher scoring responses focused on a named pollutant eg smoke / smog and commented on the environmental and anthropogenic reasons for both dispersal and severity. Some did this systematically, eg anthropogenic factors affect dispersal, then those affecting severity, and then the same approach for environmental factors. They also tended to include an evaluative comment at the end of each paragraph and support their answers with examples. However, many students presented only one side eg negative anthropogenic factors leading to severity rather than also looking at management. Despite this there was often some good science in these answers as students brought in elements of the pollution part of the specification and explained how the factors increased either dispersal / severity. Overall, a well attempted question, with the lower scoring students (Level 1 or 2 responses) either running out of time or not addressing severity and dispersal explicitly or focusing on the impacts of pollutants rather than the environmental and anthropogenic factors affecting the pollutant.

Question 11.2

Despite having a similar mark distribution to question 11.1 and similar mean mark, this was by far the most popular option (taken by over 60% of students). Despite the popularity of the question this provided more opportunity for generic responses as some students struggled to focus on the anthropogenic and environmental factors affecting choice and use: often just focusing on choice or use. Some lower scoring students were limited by their lack of understanding of the word anthropological. However, higher scoring answers discussed the factors eg geological proximity to geothermal, meaning that it was an option, yet also identified reasons why it may not be used, for example cost of technology or tectonic instability. These students also identified parts of the world where there were more / less likely to experience the issue, through examples. Alternatively, some students addressed the temporal aspect eg linked to choice over renewables. While there were some students who attempted a conclusion there were many who did not. Reflection on choice or use, either as a summative comment at the end of each point, or overall, helps with moving through the levels, and demonstrating evaluation. Those students with clear structure in their responses by systematically going through energy types or applying the factors to use and choice often found it easier to write coherent responses. Some students made excellent use of a table in their plan which also helped structure their response.

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Mark Ranges and Award of Grades

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