A-LEVEL
ENVIRONMENTAL SCIENCE

7447/2: Paper 2
Report on the Examination

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The majority of students attempted all the questions on the paper, including the mathematical questions. On the whole, the content appeared well revised, however, some questions were not carefully enough interpreted. This was especially evident where the question structure required two parts and students only focused their answer on one e.g. question 04.1 and 05.4.

The practical questions were generally well answered, although some lack of detail in application to the specific scenario cost many students a few marks.

The mathematical aspects were better attempted than previous years, however some simple calculations such as percentage change and significant figures still pose problems for many. Students should be encouraged to show their working to allow for error carried forward and not to round their results part way through multiple stages of a calculation, which can lead to significant errors.

A wide range of responses were seen in the levels of response questions (09.4, 11.1 and 11.2). Many students struggled to express their ideas, in clear, concise, and scientific language. Although there were some excellent answers, many lacked the scientific detail and coverage of a wide range of content to achieve the higher levels. Within the essays in particular, the introductions were often superficial and the conclusions were repetitive of the content already covered.

Question 1

The terms niche and plagioclimax were answered by most students. Biological corridor was also well answered, although some gave slight variations of the term, such as wildlife corridor which did not achieve the mark. Poorly worded descriptions of gene pool resulted in some students missing the mark, for example *all the genes in a species*. Rewilding was not well answered with students often simply describing species reintroduction.

Question 2

02.1

More than 50% of students did not achieve the mark available for this question. The most common reason being that students did not give reference to a standardised unit of comparison.

02.2

An accessible question with 73% achieving the mark. A very wide range of answers were given, with photosynthesis and respiration being the most common. Only *processes* were credited not *cycles,* which consist of a number of processes.

02.3

Solar energy was often cited followed by an explanation that this reduces the use of fossil fuels and therefore emissions of carbon dioxide. Those who only achieved one mark often either did not name an alternative resource or they only stated that renewables do not emit carbon. It was necessary that answers explained that it is the reduction in fossil fuels that is important and not just the use of renewables.

Question 3

03.1

A well answered question that also differentiated well. Pest control, reduced disease transmission and reduced predation were the most common answers given. Overpopulation was not credited without a reason for why it causes an impact. A few confused answers gave reasons why species may be exploited such as for food or traditional medicines.

03.2

Less than 40% of students achieved the mark available. Common reasons for not achieving the mark included not reading the graph correctly and some only giving their answer as 5% of 8750, rather than 95%. A significant proportion of students read the graph and calculated the percentage correctly but did not round their answer to a whole fox or they rounded down to 8312 incorrectly. A few students rounded 437.5 to 438 part way through their calculation which resulted in an incorrect answer or simply made a transcription error from one stage to another.

03.3

Most students showed a clear understanding of the features of an r selected species. However, in some cases did not link this to the ability for rapid population recovery. Many simply stated that it allows a population to increase, missing the important element of rapid increase or rapid population recovery. A lack of scientific language prevented some students from accessing the second mark, for example using phrases such as ‘the population can bounce back’ rather than ‘able to increase rapidly’. A very small number completely misinterpreted the question or did not know about r selected species and wrote unrelated answers about food supply or the foxes being legally protected.

03.4

Students gave good reasons to suggest why the population may not have decreased as expected, often giving fewer predators or an increase in food. However, there was a lack of detail in the explanations given and as such only a small number gained full marks and just under 50% gained two out of the four marks available. Students needed to explain their reason using technical concepts of population dynamics, rather than simple and repetitive statements such as ‘an increase in food meant there was more food for the population to increase’. Instead they needed to refer to a reduction in intraspecific competition or an increase in carrying capacity.

Question 4

04.1

Students generally structured their answers very well by naming a net design feature and detailing how it reduces bycatch. However, a few failed to include enough detail in how their named fishing method reduces bycatch, or failed to name a specific fishing method. Most students referred to increasing mesh size to allow smaller fish to escape and the addition of TEDs to allow species such as turtles to escape. There were a good range of net designs given. Just over half of students gained one mark and around a quarter gained both of the marks available.

04.2

Those who did not achieve high marks in this question did not consider the size of the net in their calculations or evaluations. However, many did calculate the bycatch and shrimp catch per trawl and some made a reference that this did not account for the difference in net size. Some good links were made to the environmental damage caused by the increased number of trawls required with the new net.

04.3

Well answered with a range of variables and clear explanations. A few did not give a valid explanation, instead gave simple answers such as ‘to make the test fair’ or ‘so the results are accurate’, rather than giving details of exactly how their variable would otherwise affect the validity of the results. Around 70% of students gained the full 2 marks and approximately 10% only gained 1 mark.

04.4

This was a well answered question, with approximately 60% achieving full marks and around 40% gaining 1 mark. The most common answers being habitat damage, increased turbidity and ghost fishing. Many answers included excellent details, referring to specific habitats being destroyed such as seagrass and impacts of sediment disturbance blocking light for coral polyps. A few students did not achieve two marks since they gave the same mark point twice e.g. seabed damage and destruction of habitats, or gave an answer not specific to just trawling such as oil pollution or stated high bycatch without referring to ghost fishing.

Question 5

05.1
Many students gained the full 2 marks for this maths question, while approximately 10% gained one mark, around 5% did not achieve any marks and a number of students did not attempt the question at all. Those who achieved one mark most commonly received it for calculating the mean number of penguins.

05.2
The remote techniques were answered better than the answers for how they increased accuracy. Many students gave satellite imagery or cameras as a remote sensing technique and correctly stated they can be used to count individuals in the population, although some did not present this very clearly. Mark release recapture was regularly seen but not credited since it is not a remote technique. Answers that did not achieve any marks did not fully name a technique or they simply stated that the technique increased the accuracy without detailing how.

05.3
Around 60% of students gained the mark for this question with the most common answers being for repeating the study in different seasons and take multiple readings.

05.4
Answers showed a good understanding of activities that are not permitted on Antarctica but students did not always go on to describe how they specifically protect Antarctica. The Antarctic

Treaty was commonly used as was the Montreal Protocol in conjunction with how it bans CFCs leading to recovery of the seasonal hole in the ozone layer.

Question 6

06.1
Only a third of students gained the mark available. Some students simply described the stages in the Figure 2 diagram without mentioning the element of genetic identity. The terms cloning, and asexual reproduction were most commonly used.

06.2
A well answered question with around three quarters of students gaining the mark. Most students gave a very clear statement of no difference. A few incorrectly gave the alternative hypothesis instead.

06.3
Students gave good answers in reference to controlling relevant variables. A lack of careful thought about how the growth would be measured was evident. The stem of the question gave details that 500 plants were grown in the different nitrate concentrations, but very few thought to calculate a mean. Standard deviation was not a common answer but some did state that a statistical test should be used to test for significance.

06.4
Students who only achieved one mark usually missed the first mark point by not stating the feature of a monoculture crop, but did go on to give an environmental factor that they are more vulnerable to. Increased risk of disease or pests were the most common answers given, followed by increased competition for nutrients. A few gave very confused answers stating that there would be more space for the plants or that they have varying nutrient requirements.

06.5
Well answered with GM and selective breeding being the most commonly used mark points, along with pest and disease resistance. Some students did not give a specific technique but instead repeated the question using the phrase gene manipulation. Some students used ‘high yield’ as a trait to select for, which also repeats the question. It was necessary to specify a trait that would lead to high yields. Golden rice was not credited since it increases nutrient content rather than yield.

Question 7
07.1
Well answered with increased turbidity and dissolved metals mostly commonly given answers. Some students merely said that ‘it would change/alter the turbidity’ but were not specific about how, so did not achieve the mark. There were many incorrect references to reduced dissolved oxygen linked to fewer plants and photosynthesis.

07.2
While this question differentiated well, some answers were too vague to achieve marks such as ‘it would allow species to thrive’. There were some well answered responses with specific details of impacts to food webs along with a clear understanding of the denaturing of enzymes and dissolution of exon-skeletons. Some students gave excellent accounts of the impact of pH on metal solubility and linked that well to bioaccumulation.

07.3
Surprisingly this question was not well answered, with only 36% achieving the mark. An array of incorrect answers included chromatography paper, iodine test, and the addition of crushed lime. Litmus paper was also a common answer that did not achieve the mark. Some students did not give a full enough answer, failing to give the colour chart with Universal Indicator or calibrated with pH meter.

Question 8
08.1
Moderate or regular rainfall and no extreme annual temperature variations were frequent correct answers. Some students gave microclimate features within the forest such as higher light levels rather than climatic features, or even characteristics of the soil and biodiversity.

08.2

A well answered question with around half of students % achieving full marks and nearly three quarters achieving at least one mark. The term detritivores was well used in the question. Some gave good answers related to a biotic factor and a soil feature but failed to link the two with an explanation of how the biotic factor resulted in the soil feature. Those students who gave a biotic factor and process, but went on to state that it increased soil quality or fertility did not achieve the second mark point. A specific soil feature was required. The use of the term ‘affects nutrients’ rather than ‘increases nutrients’ also prevented some students achieving the second mark. Those that did not receive any marks usually gave answers lacking specific details such as ‘more soil biota means that the soil will be more fertile’ or gave a confused answer related to an abiotic factor.

08.3

This was a very accessible question with approximately 20% achieving full marks and around 65% gaining two marks. Some answers extended beyond the question of data collection and gave examples of data analysis, such as calculating a mean or using a statistical test. This was not needed here since the question was only concerned with data collection.

08.4

This proved to be a difficult question with more than 40% of students not achieving any marks. Many students gave weather as a variable without specifying cloud cover.

08.5

Around 55% of students gained the mark in this maths question. Students who only partially answered the question usually calculated 16 correctly but gave 1.5 or 2 instead of 1 and therefore did not sum correctly. Very few did not attempt this question.

08.6

A demanding question where only approximately 10% scored full marks and more than 60% scored no marks. Many students were confused about how to interpret the results of the Mann Whiney U test, often giving two outcomes, one for each u value and that site A wasn’t significant but site B was, rather than the difference between them. Some just said that there is a big difference without referring to the data.

08.7

A well answered question with approximately 70% achieving full marks. Students most commonly answered with reduced interception and increased surface run off.

Question 9

09.1

Students who did not gain both marks often did not give a specific way in which the magnetosphere protects the Earth from harmful solar winds or they commonly stated that it protects Earth from UV radiation. Some students confused the magnetosphere with gravity or stated that it prevents extreme temperatures rise.

09.2

Very few students achieved full three marks on this challenging maths question. More than 60% of students did not gain any marks. A common mistake was not adding 70 years to 10900. However, this error carried forward still enabled students to achieve the remaining two marks. Some calculated each stage correctly but did not round their final answer to two significant figures.

09.3

Those who achieved the mark usually described that it would get hotter in the day and colder during the night because of the longer time period facing toward and away from the sun. Most often those that did not achieve the mark stated that the temperature would increase only or that the temperature would fluctuate. Confusion over orbit and rotation was evident as some answers described how seasons would get longer.

09.4

Level 3 answers demonstrated expanded points where students gave a description of a named research method and linked it to features of the data that exemplified improvements or how it provided data on features of the environment important for the conditions for life on Earth. Some excellent explanations of oxygen isotope analysis, and the limitations of dendrochronology were seen, along with computer modelling.
Level 2 answers often listed a number of methods without much development, these answers lacked focus on the question title or only included one element of it. Those answers that gave a good account of the features of the environment that may be monitored and linked this to how they relate to the conditions for life on earth but did not include specific research methods only achieved a Level 2.
Level 1 answers either gave inaccurate details of methods or gave a general discussion of improvements in technology without any specific methods.
Some answers brought in the use of wildlife monitoring equipment and linked this to an improved understanding of how species interact with their environment, gaining some credit. Very few only focused on the general research methods used to devise ecological studies from 3.7.1 scientific methodologies and 3.7.2.1 standard environmental techniques, which alone did not gain much credit. A few listed the conditions for life without linking research methods.

Question 10

10.1

A common reason for no marks being awarded was an answer that only described the data, rather than giving reasons for the changes. The most common answer given for the first mark was an increase in population, followed by affluence and for the second mark the increase in greenhouse gas emissions from the increased use of fossil fuels. Some students missed the second mark by not giving enough detail of the impact that caused the ecological footprint to increase e.g. more food consumed.

10.2

Many students read the graph incorrectly producing values of 10 and 21 instead of subtracting the carbon footprint data first to give ~5 and 13. If they then correctly calculated the percentage change they received one mark with error carried forward. However, many incorrectly carried out 10 as a % of 21, or 21 as a % of 10, instead of finding the difference and the % change. If students do not show their working it is not possible to credit error carried forward.

10.3

Students found this multiple-choice question challenging with less than 10% gaining the mark.

10.4

A well attempted question, with good differentiated marks. The most common reason for achieving only two marks was not plotting the value on the graph as a continuous vertical line. The most common reasons for only achieving one mark was calculating 58% of the mean data rather than 42%. Students who read the graph incorrectly but went on to correctly calculate 42% achieved one mark by error carried forward, and two marks if they went on to plot that value. Students should be encouraged to always show their working so these marks can be awarded. They should also be encouraged not to round during stages of a calculation, to avoid inaccurate answers.

10.5

Many students made the connection of low biocapacity but high biocapacity per capita linked to a small population. However, some answers relating to mark point two were not specific enough, for example some stated that this region had high biodiversity rather than naming a habitat with high productivity. Tropical coral reefs, rainforests and mangroves are all examples the students should be familiar with, any of which they could have used. Some students confused biocapcity with ecological footprint and gave reasons such as high affluence leads to unsustainable lifestyles.

Question 11

11.1

Many students included discussion on ecological succession. Some went into detail about the process of primary succession but did not link how an understanding of these processes can be used to make conservation more effective. Those that highlighted elements of competition and the change in optimum conditions for particular species or the presence of unique communities in different series and linked this to the rationale for plagioclimax management reached the higher

levels. Captive breeding and release were also commonly discussed where, students could more clearly link the understanding of breeding triggers to the success of breeding outcomes and habitat requirements with soft release programmes. Students who reached higher levels gave specific examples and more coherently explained how an understanding of these factors leads to greater conservation success. Interspecies relationships, specifically pollination, seed dispersal and details of key stone species was also well referenced and applied well to the question. A few students broadened their scope and included application to farming and fishing environments, including the impact of pesticides on non-target species and fishing above the MSY. Some answers focused on only abiotic factors involved in more global scale processes of the biogeochemical cycles, which were more complex to link to the application to conservation. Overall there was a good use of environmental terminology. Those who achieved a higher level expanded their points well with specific details, focused on the question throughout and gave a range of examples. Those who achieved level one often gave unrelated information or did not give any specific detail. Level two answers were often lacking in application to conservation and level three answers attempted to do this but would have benefited from either a longer answer or a wider range of information in greater depth.

11.2

Very varied responses were given in contrast to 11.1. Most students attempted a definition of dynamic equilibria at the start, but this often lacked clarity or accuracy. Most answers focused on feedback mechanisms and the higher level responses linked this to their role in maintaining dynamic equilibria. Carbon in the atmosphere was the most common example used leading to discussions on climate change and the management of greenhouse gas emissions from fossil fuels by renewables and sequestration via photosynthesis and afforestation. Higher level responses linked the concept of dynamic equilibrium well, but rarely were transfer rates referenced. Examples of positive feedbacks were frequently given, as was the concept of tipping points, adding value where discussed clearly. A few interesting responses were seen where students detailed geoengineering projects in attempts to restore dynamic equilibria. Some good responses were seen on disruption of dynamic equilibria in the hydrosphere, with clear relationships to over abstraction and water conservation measures. The nitrogen and phosphorus cycles were also discussed by some often in the context of agriculture, however this was less well linked to the focus of the essay.

Some students gave extensive references to the circular economy, some focused the whole essay on this one concept. Although this topic has relevance, clear relationships with dynamic equilibria were often missed. Responses which only achieved lower levels often lacked scientific details of environmental systems in dynamic equilibrium or how they are disrupted. Sometimes the response quickly lost focus and the essay became predominately about sustainability.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.