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FOREWORD

This booklet contains reports written by Examiners on the work of candidates in certain papers. **Its contents are primarily for the information of the subject teachers concerned**.

ENVIRONMENTAL SCIENCE

GCE Advanced Subsidiary Level

Paper 8290/01
Paper 1

General comments

As only a small number of candidates took the June 2004 paper the comments on candidate performance are, in comparison with former sessions, fairly brief. Additionally this formed the penultimate session for the 8290 specification and future reports will focus in much more detail on the requirements of, and responses to, the new examination.

This paper drew candidates from a wide range of ability with marks ranging from confident grade A's through to some failures. As one would expect, the better papers revealed a very good understanding of the content of the Environmental Science Syllabus coupled with the ability to cope with data response questions. Weaker candidates achieved marks within the easier data response questions but did not cope with the longer descriptive questions.

Comments on specific questions

Question 1

This question revolved around an understanding of Biomes and Ecosystems. Whilst most candidates showed a clear understanding of Biomes and Ecosystems only the stronger candidates related climate to vegetation and could clearly describe a plant succession.

Question 2

Answers to this question were quite mixed. Although the majority of candidates achieved high marks for interpreting the rock cycle, very few were able to briefly describe and explain Limestone and Granite. It is possible that this lack of understanding contributed to some very poor interpretations of the two soil profiles. The clue to good quality answers for this Part **(c)** was to follow the wording of the question and describe the soil profiles in terms of the progressive weathering of Limestone and Granite; whilst soil texture was often accurately described there were few correct interpretations of soil chemistry.

Having said this it must also be stated that a small number of candidates achieved very high marks for this question and should be congratulated.

Question 3

This question was answered reasonably well by the majority of candidates. Although there were some inaccurate drawings of anticyclones, the remainder of the question was well understood and answered. Only a very small number confused anticyclones with cyclones.

Question 4

This question proved to be one of those questions in which candidates either knew it and did well or did not know and did badly; answers were either very good or very poor. There were some excellent descriptions relating seismic waves to the structure of the earth. These answers displayed a good knowledge of variations in rock density and how each of these waves revealed earth structure. Some weaker candidates did not answer this section. Although marks for the remainder of this question varied, significantly more candidates understood the basics of plate tectonics and continental drift.

Question 5

This question on the Nitrogen Cycle was the salvation of a significant number of candidates. The question developed around a correct interpretation of a nitrogen cycling model, which most did quite capably. There were some detailed descriptions of nitrogen fixation, denitrification and the various factors that contribute nitrogen to both the atmosphere and the soil.

Question 6

Responses to this question were quite varied with the majority of candidates achieving between 8 and 12 marks out of the 14 available. In the main answers to **(b)** obtained high marks. The term *Albedo* was well understood by the majority of candidates and they were able to apply it to the diagram of different reflective surfaces. **(a)** was less well answered with many candidates not understanding why incoming radiation experienced losses due to reflection, absorption and scattering; diffusion as an atmospheric process was not understood.

Question 7

For most candidates this question was well answered and there were a small number of excellent responses. Although most understood how a country's population could remain unchanged, other parts of the question were poorly answered. Few candidates recognised that for there to be a rapid increase in population there are two scenarios. Firstly the high birth rate, stated by many, would have to be accompanied by a fall in the death rate and secondly, sudden migration might produce a rapid increase in population. **(c)** was well understood and well answered.

Conclusion

Although this formed the penultimate session for the Environmental Science specification there are some promising portents for the new Environmental Management Paper to be taken in 2005. Hopefully the new specification titled Environmental Management will enable candidates and Centres to draw upon their knowledge and understanding of many of the topics contained within the current syllabus within a newly styled examination. The new examination paper will contain a mixture of data response questions similar in form to those currently used, along with a more discursive section concerned with the management of environmental issues drawn from: The Lithosphere, The Hydrosphere, The Biosphere and The Atmosphere.

Paper 8290/02

Paper 2

General comments

The standard of many scripts was rather disappointing. Candidates did not have sufficient depth of knowledge to give the detailed answers that are required at this level. Too often answers were insubstantial – "causes pollution" or "too expensive" being the type of vague response seen. Answers such as these do not give any indication of real knowledge of the subject and do not gain marks. Reasons and explanations with a scientific basis are needed. Candidates must read questions carefully and make sure that their answers are relevant. Too often candidates will ignore the question and home in on a single word such as "ozone", writing all that they know about it while this may have no relevance to what is being asked.

Comments on specific questions

Section A

Question 1

(a) Most candidates did not answer the question set, which referred to the temperature variations *over* land and sea. The rate at which land or sea gain and lose heat is important in comparing temperature variation but mechanism of the formation of land and sea breezes is not really relevant. Many answers consisted only of this.

(b) Changes in the local climate were expected to be along the lines of drier summers (less evaporation) and greater seasonal variation in temperature due to the smaller quantity of water in the lake. The smaller quantity of water stores less heat for release in the winter and is less effective at cooling land in the summer.

Question 2

(a) Candidates understood that this was the Sun.

(b) References to reflection and absorption, whether by crops, land or clouds, were irrelevant here. Few candidates realised that some light would miss the crop, falling on the soil or non-crop plants or that crops might not be grown all year.

(c) Reflection, light falling on non-photosynthetic parts and only some wavelengths used were all correct answers seen, although references to the wavelengths of light used in photosynthesis were not often accurate.

(d) Good answers made reference to the second law of thermodynamics and related this to the uses of the products of photosynthesis.

Question 3

(a) The question asked for a description of the differences between the two pyramids, not an account of social conditions. There should have been more reference to comparisons of figures from the pyramids, as well as references to death rates, birth rates etc.

(b)(i) Most candidates knew that this would be country **A**.

(ii) This was answered well, with candidates giving a good account of social changes that would produce this result.

Section B

Option 1

Question 4

(a) The idea that fossil fuels arise from organic materials was generally understood but not always clearly expressed. There were often good references to the very long time scales involved in formation.

(b) Candidates were all familiar with appropriate examples.

(c) Accurate, detailed knowledge was sometimes lacking, with few references, for example to the anaerobic conditions needed in the production of coal.

Question 5

This question tested candidates' ability to apply knowledge in new contexts. This was something that most found difficult to do.

- Many candidates did not appear to note the reference to ozone in the question but described the effect of a standard catalytic converter, which did not answer the question. Some answers referred to tropospheric ozone and its harmful effects but not the way in which cars play a part in its formation.

- Candidates seemed to have no knowledge of the effect of hydroxyl radicals in changing NO_x to harmless N_2 and O_2.

- There were few references to CO_2 as the product of combustion but candidates were aware of it as a greenhouse gas and the dangers of its increased concentration in the atmosphere.

Question 6

(a)   There was a lack of adequately detailed knowledge here with frequent confusion of the terms *atom* and *molecule*.

(b)   Technical difficulties in providing necessary conditions and controlling energy release in nuclear fusion were the points looked for but seldom seen in candidate's answers.

(c)   There were some good responses, giving specific advantages but there were too many vague "does not produce pollution" responses. This is inaccurate, needing to be qualified or explained, with reference to low greenhouse gas emissions, for example. Likewise, "too expensive" is too vague to gain credit as a disadvantage, with qualification about high cost of plant needed to gain a mark.

Question 7

(a)   This was generally well answered, with candidates raising interesting points, amongst others, about the effect on migratory birds if the wind farm was situated on their route and other concerns if a site was of particular scientific interest environmentally.

(b)   Candidates must be careful not to use the word *re-useable* in place of *renewable*. The two terms are not synonymous.

(c)   Again, this was generally well answered, the commonest answer referring to greater wind reliability offshore, although some candidates found it difficult to express this idea clearly.

Question 8

(a)(i)   Most candidates gave the correct answer, *joules*.

(ii)   The formula E = mgh was well known.

(iii)   There were fewer correct answers here. Candidates should be able to list ways in which energy is "lost", such as friction and sound.

(b)   Candidates seemed well aware of problems and hazards associated with dam construction, such as the environmental impact of flooding land to create the reservoir and siltation, amongst others.

Question 9

(a)   Most candidates knew that the gravitational pull of the Moon and the Sun are responsible for the formation of tides but few could give more detail in their explanation, by referring to the Earth's rotation and tide frequency or the difference between spring and neap tides.

(b)(i)   The general principle of the functioning of a barrage was described but there was little accurate detail and a number of candidates confused tidal power with wave power.

(ii)   The advantages of renewable energy without greenhouse gas emissions were stated but a number of candidates maintained that a disadvantage would be that tides are unpredictable, when, in fact, their very predictability is an advantage.

Option 2

Question 10

(a)   Most candidates gave the correct answer and showed their working, as the question asked.

(b)   The idea of sand straining or screening particles was usually expressed but candidates did not appear to have any real knowledge of water purification processes so detail such as the presence of micro-organisms on the sand grains, to decompose organic material, were missing.

(c)   The idea that chlorine can produce an unpleasant taste in the water was expressed by many candidates but some see the terms *ozone* or *ultraviolet radiation* in a question and promptly begin to describe the harmful effects of these in other contexts. Candidates must read questions properly and not home in on single words without paying attention to the context in which they appear.

Question 11

(a)   This was well answered. Candidates gave good accounts of the effects of deforestation in terms of run-off, impact erosion and the effects of tree roots and leaf litter in protecting the soil.

(b)(i)   Good definitions were given in most cases.

   (ii)   The effects of *eutrophication*, on aquatic organisms, were very well described.

Question 12

(a)   Tropical (a suitable description was accepted) with trees and grass would be a typical climate and vegetation where *ferralsol* would be found. Typical vegetation did not seem to be known by many candidates.

(b)   The nature of a ferralsol was much better known and there were good accounts giving reasons for low fertility of such soils, with explanations of the effects of leaching and the rapid decomposition of organic matter.

(c)   The hardness, red colour and lack of humus were all points that could have been listed but few were able to give suitable features.

Question 13

(a)(i)   Many candidates seemed to have little knowledge of the way in which a landfill site functions and could not explain that leachate forms from seepage through landfill, to give a liquid that is likely to be toxic.

   (ii)   Where candidates understood the nature of leachate, they were able to state that it could contaminate ground water sources. Again, lack of knowledge meant that few gained marks when describing the problems of landfill gas, which are its flammability and that it enhances the greenhouse effect.

   (iii)   The use of impermeable liners to contain leachate and collection or controlled burning off of landfill gas were the answers looked for but seldom seen as candidate's lack of knowledge of the topic let them down.

(b)   The need for large areas of land, the problems with smell and vermin were all answers that would have been appropriate.

Question 14

(a)   Candidates showed a good ability to sort out the information and gave correct answers to the calculation.

(b)(i)   Some candidates thought that a calculation was required here but the correct answer named the energy requirements, which were *transport of raw materials* and *bottle factory and transport to bottling plant*.

   (ii)   This calculation proved more difficult. The steps should have been:

   energy used per trip after the second trip = $3.6 \div 2 = 1.8$kWh,

   one trip for the non-refillable bottle uses 1.9kWh.

   (iii)   The idea that there would need to be transport back to the bottling plant for re-filling, as well as to the shop, was noticed by some candidates.

Question 15

(a)(i)   There were good answers here, referring to tanker accidents and practices such as washing out tanks at sea, as well as coastal pollution caused by refineries and other industries.

(ii)   Candidates gave particularly good descriptions of the damage to seabirds here. Reference could have been made to effects on tourism as well as the environmental effect on other marine life.

(b)   This was very well answered, with accurate and detailed descriptions of techniques employed.

Option 3

Question16

(a)   This required an explanation in terms of a mechanism for evolutionary change, with correct use of terms such as *variation*, *competition*, *selection pressure* and *allele frequencies*. This was not seen.

(b)(i)   The correct answer was that all seedlings survived in Batch B but not in Batch A. Stating that the number of seedlings that survived in Batch B "stayed the same" was not sufficient.

(ii)   Candidates correctly stated that the mean height was always greater in Batch B.

(iii)   This required candidates to use the data supplied to relate copper content of soil at different distances from the mine to an allele for copper tolerance and the effects of natural selection on the occurrence of this allele. This was not seen in candidates' responses.

Question 17

(a)   The increased demands of a larger population for food and the reduction in the amount of land for agriculture were examples of correct answers given by candidates.

(b)(i)   The term *monoculture* was not understood. It is the growing of a single crop on the same land year after year.

(ii)   Unless the idea of monoculture was understood, candidates could not explain that the same nutrients were being taken from the soil year on year.

(iii)   There appeared to be little knowledge of the effects of pesticides in the environment. Candidates seemed to think that they would "get into the crops and kill them".

(iv)   Vague references to pollution have no relevance here. The idea of compaction brought about by the use of heavy machinery was the point looked for.

(v)   The idea of maintaining vegetative cover was the only idea expressed, without details of techniques that might bring this about. Contour ploughing, terracing and the use of mulches and wind breaks are some of the points that could be made.

Question 18

(a)   There seemed to be an inability to extrapolate information from the data. It should have been clear that an increase in population required an increase in areas cleared so that the regeneration period for any area is then reduced.

(b)   The data clearly shows a decline in soil fertility but this was not seen by candidates.

(c)   Reference could have been made to the reduced time available for recovery, hence less forest regeneration and less ash to add nutrients at the next clearance.

Question 19

(a)(i)   The answer required the idea that rate of catch exceeds rate of replacement.

(ii)   Here the points that should have been made were that a smaller catch results from the same effort and that there are fewer large or mature fish.

(b)(i)   Reference to the effects of larger mesh on the size and maturity of fish that are caught or escape was needed.

(ii)   Candidates should have been able to draw conclusions about the damaging effects of this type of fishing on the sea-bed and the fact that the catch is unselective in terms of organisms.

Question 20

(a)   There seemed to be little knowledge of hunting or ranching, with this section left blank. Candidates must ensure that they have some knowledge of all areas of the option they have studied, if they are to stand a chance of gaining a good mark.

(b)(i)   As it was clear that this question referred to herds and ranching, the answer should have been in terms of the stocking rate.

(ii)   Overgrazing, reduced production and soil erosion were all points that could have been made.

(c)   Reduced production was the only correct point made. The reasons for this should have been outlined – the occurrence of overgrazing with the resultant damage to grassland, reduced availability of grass, malnutrition and poor health of livestock.

Question 21

(a)   The idea of forests as carbon sinks and their role in the water cycle are obvious points. Their significance as habitats as well as sources of timber and other materials could also be developed. These ideas were not expressed by candidates.

(b)(i)   Erosion and flooding were consequences that candidates were aware of, as well as some limited comments on the effects on species loss but these points need to be developed more in this type of question. Lack of depth in knowledge becomes obvious.

(ii)   Candidates should have some knowledge of the ways in which forestry can be managed in order to be sustainable, such as coppicing, rotation, selective felling and replanting in temperate forests, together with legal controls over logging and sale of timber in tropical forests. This knowledge was not apparent in answers seen.

Paper 8290/03

Individual Research Report

General comments

This penultimate Environmental Science examination attracted research reports from a number of Centres. Centres are to be congratulated on the high quality of their report assessments as well as the generally high quality of both the candidates' research and their reports. Nearly all reports followed a logical sequence from an introduction and hypothesis through to data presentation, analysis and conclusions.

Ignoring the variations in the quality of the content of the reports, the Examiner's only criticism is that many are still far too long. The specification clearly states that reports should be no longer than 4000 words and it is worth noting that the 2005 specification requires reports of no more than 2000 words. The objective behind such a word limitation is to enable candidates to report succinctly on research into a manageable topic which utilises field study and laboratory investigation; wide ranging topics such as impacts of climatic change or oceanic pollution tend to be self-penalising.

Comments on specific skills (C1, C2 and C3)

Skill 1 Research and Planning

Marks for criteria (a), (c) and (d) were generally completely satisfied with most candidates achieving 2 marks for each. Weaker reports often were unclear about a hypothesis or how the methodology would effectively test the hypothesis. It is always better to clearly and precisely state one clear hypothesis that can be tested through the research. Having established the central themes for the research it is then worthwhile the research methods should be given a trial run in order to verify how effectively the hypothesis can be tested.

In the main the reports of this session did reveal the thorough preparation to enable the collection of both workable and interesting data.

Skill 2 Data Collection and Presentation

The best ever! The quality of data presentation in this year's projects was of a very high standard. Candidates obviously spent a great deal of time in collating their data and presenting a variety of graphs, tables and illustrations of the highest quality. As the majority of candidates endeavoured to verify their findings through simple statistical testing, high marks were obtained for this section.

Skill 3 Conclusions and Evaluation

For a significant number of this year's candidates this proved to be the weakest part of the reports. Although the strongest reports provided full evaluations there were still weaknesses. Criteria (c) and (e) continue to be well covered and candidates are clearly aware of the environmental considerations attached to their research. In criteria (a) only the strongest candidates critically assessed their methodology and wrote full explanations; other candidates (often achieving 1 mark) were prone to sweeping generalisations such as 'there was little time' or 'I should have chosen more sites'. Criterion (b) should develop out of (a) and be fairly straightforward. However only a minority of candidates provided justified alternatives to the limitations previously outlined. For some candidates the main difficulty with criterion (d) was that whilst general conclusions were made, it was often without reference to the data.

Having made these criticisms Examiners must however make the point that the majority of the conclusions were relevant and in drawing together the environmental implications of the research, were interesting to read and creditworthy.

General conclusion

Examiners would firstly like to repeat their congratulations on the quality of this year's reports; they were well presented and written. In relation to the new Environmental Management specification which will be examined for the first time in summer 2005 there are some points Examiners would like to raise:

- The word limit has been reduced to 2000 words and it is important for the scale of the research to be scaled down.

- Such shorter projects should avoid lengthy preambles.

- There is a need for relevance to the title and succinct presentation of results and analyses.

- Both Centres and their candidates must pay careful attention to the specification requirements.