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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

Due to the introduction of the new Syllabus 8291 in May/June 2005, this is the final examination report for the Environmental Science core paper (8290). In addition to reporting on candidate performance in the November examination, it will also provide some advice on the new style of examination to be seen from May/June 2005.

The November session of 8290 attracted candidates drawn from Centres in Argentina, Finland, Zimbabwe and Malaysia. Unlike some previous papers candidates did not show an obvious preference for a small number of questions and according to the varied levels of ability, there was a fairly equal input into each question. In the main, candidates were well prepared for the examination and the general level of achievement was slightly higher than in previous sessions. Candidates used their time well and gave each question sufficient time. The quality of written English was generally of a high standard and there was some excellent use of the vocabulary of Environmental Science.

Comments on specific questions

Question 1

This question was moderately well answered with most candidates achieving between five and eight marks. Whilst part **(a)** posed very few difficulties, few candidates did well in part **(b)**. The question required an *explanation* of the current location of continents in relation to their location 200 million years ago. The majority of answers dwelt upon a description rather than an explanation and ignored important tectonic processes such as continental drift, convection currents and ocean floor spreading.

A very small number of candidates completely misread the question and described the features of convergent and divergent boundaries.

Question 2

For many candidates this proved to be quite a difficult question. Its aim was to examine, through prompt material, some river processes that help to shape the landscape. Whilst candidates showed a sound understanding of weathering and erosion, the same was not always true of their analyses of river landforms and processes.

Only a small number of candidates mentioned the need for vertical erosion to shape the valley shown in the photograph, attrition as a process that shaped the boulders in the river bed and that variations in river energy are responsible for the sediment in a river channel. There was some considerable confusion between river and glacial processes in the production of the features shown in the photograph.

Question 3

This question focused on remote sensing and was generally well answered. Candidates were well versed in the characteristics of electro-magnetic radiation and with the exception of part **(c)(iv)** they coped quite well with the interpretation of a weather satellite image. Although some candidates wrote excellent accounts of how satellite images can be used in making weather forecasts a significant number were content to describe the content of such images; these candidates lost sight of their use in making forecasts.

A small number of weaker candidates confused anticyclones with cyclones and thought that the darker areas were cloud covered and the white areas had clear sky.

Question 4

There were few difficulties encountered in answering this question. Parts (a), (b) and (c) elicited some almost textbook definitions and there were few difficulties in interpreting the data in (d); the best candidates often obtained full marks for this question.

Question 5

Responses to this ecology question were somewhat mixed. As with **Question 4** many candidates were able to provide textbook definitions in part (a), and accurately interpret data in part (b) sections (i) and (ii). The latter part of the question examined the ecological qualities of an area via a description of plant succession and an examination of soil characteristics within the same location. Many answers made some general comments about humus and water retention but failed to consider soil texture and chemistry. As with past papers there is still confusion over how pH values indicate levels of acidity and alkalinity e.g. high numerical values refer to acid conditions is often seen.

Question 6

Although most candidates were able to interpret the data provided in (a)(i) and (ii) and (b)(i) the more discursive aspects of the remainder of the question which focused upon global warming and greenhouse gases were less well answered. Although most recognised that carbon dioxide and methane are important greenhouse gases, the inclusion, in many answers, of cfc's led to confused statements about ozone depletion being the cause of global warming. The final part of this question was spoilt by simplistic references to both climate and the biosphere (one was required) or incorrectly describing various impacts upon the hydrosphere. The question was concerned with the impact of global warming *upon* either the climate *or* the biosphere.

Having made this criticism, it is worth stating there were a small number high quality answers that were completely relevant and scientifically sophisticated.

Question 7

The majority of candidates obtained good marks for this question. Predator-prey relationships were clearly understood and the concepts of exponential population growth in relation to carrying capacity posed few difficulties.

Conclusion

June 2005 sees 8290 replaced by the new syllabus titled Environmental Management (8291). It is important for Centres to recognise that its content has evolved out of the old Environmental Science paper. Within the confines of the new specification it will continue to be important for candidates to develop their skills in interpreting a wide range of data including maps, photographs, diagrams, tables and graphs. Unlike the former 8290 Paper 1, a much larger element of the new examination will be devoted to the analysis and discussion of environmental issues and their management. Candidates will be able to make a choice of one two part essay question from each of the areas; hydrosphere, biosphere, lithosphere and atmosphere. In each case there will be the opportunity to select illustrative material with which the candidate is familiar.

It will therefore be important that candidates:

- continue to manage data response questions effectively
- pay careful attention to the wording of essay questions by noting key words and phrases
- achieve relevance throughout their answers
- use relevant examples
- where necessary, illustrate answers with simply labelled sketch diagrams
- briefly plan their essays
- and use their time effectively.

Examiners would like to thank Centres for the support they have given to the Environmental Science Paper and hope that they will enjoy preparing their candidates for the new Environmental Management Paper.

<p>Paper 8290/02</p>

<p>Paper 2</p>

General comments

There were some excellent scripts, in which candidates demonstrated an ability to apply their general knowledge of topics in the syllabus in **Section A** and then went on to give good, detailed answers to questions on their chosen option. Candidates made good use of the time available and no-one seemed to have problems in completing the paper. Candidates must read questions carefully, to ensure that the answers that they give are relevant. Where data is provided, whether numerical, graphical or photographic, candidates should use this in their answers. If an answer is shown as having more than one mark, either several points or expansion of a point made will be required for full marks. *Describe* or *explain*, in the question wording, indicate the latter. Some candidates do not know topics in sufficient detail to give the type of answers expected at this level. It is also essential that all topics, listed in an option, are studied. There are areas of the syllabus that, year on year, seem to be unknown to candidates, as indicated in the comments on specific questions.

Comments on specific questions

Section A

Question 1

- (a)(i) Most candidates were able to give a satisfactory definition of the term *habitat*.
- (ii) Candidates correctly identified the habitat of the pigeons as 'rainforest' or a suitable habitat within this.
- (b)(i) Candidates seemed less familiar with the term *niche*. Although some gained a mark for describing it as the organism's role within the habitat, few explained further for a second mark.
- (ii) Some candidates could have used the information provided to give clearer explanations of the way the different sized branches would support different sized pigeons, so reducing competition by allowing them to occupy different niches. Candidates often seem unfamiliar with the idea of incorporating data provided to justify their explanations.

Question 2

- (a)(i) Candidates mentioned that there would be little difference in winter and summer temperatures. However, there seemed to be some confusion about the reason as some candidates seemed to think that distance from the Sun was the major factor, rather than the distance travelled by the Sun's rays through the atmosphere.
- (ii) Some candidates paid little attention to the diagram as they referred to albedo at the poles, which was not relevant. Those candidates who did appreciate the significance of the angle at which the rays would penetrate the atmosphere and, thus, the distance that they would travel through the atmosphere, missed the point that the rays would fall on a smaller area and so heat would be more intense in summer.
- (b) Most candidates gave correct reasons here, such as prevailing winds or proximity to ocean currents but a few did not read the question carefully and referred to differences in latitude.

Question 3

- (a)(i) The idea of reflection or re-radiation from the Earth's surface at **A** seemed well understood but absorption and re-radiation by the atmosphere, at **B**, seemed less well understood.
- (ii) **C** was absorption by the atmosphere and was generally correctly described.

- (b) The idea of *maintaining* sufficient temperature for life was needed and this was not always made clear.
- (c)(i) Too many candidates described effects that the enhanced greenhouse effect might bring, rather than describing ways in which it would be enhanced by the action given but this was not relevant here. There were also irrelevant and incorrect references to the ozone layer, a common point of confusion for some candidates.

(ii)(iii) Comments in (i) apply to these items.

Section B

Option 1

Question 4

- (a) These were the 1st and 2nd laws of thermodynamics. Most candidates were able to state the first law but were less certain of the second.
- (b)(i) Few candidates could define *kerogen* although they seemed aware that this was some intermediate stage in formation of fossil fuels. They should have referred to complex hydrocarbons formed from organic matter that has been changed by high temperatures produced in burial.
- (ii) As candidates were unable to define *kerogen* this also proved difficult. There should have been references to increased temperature and pressure with deeper burial.
- (iii) Most candidates were able to give satisfactory answers, with references to finite reserves and the length of time taken to form fossil fuels being the commonest points that gained marks.
- (c) Candidates were able to explain that the burning of fossil fuels would release oxides of sulphur and nitrogen. However, further detail was often inaccurate, as candidates needed to state that these gases dissolve in precipitation and *increase* the acidity of rain, which will already have an acidic pH value from dissolved CO₂.

Question 5

- (a) Few candidates who attempted this option seemed to have any knowledge of nuclear energy production. The longevity of the radioactivity in nuclear waste, together with the large amount of radiation produced by a small amount of waste and the difficulties of preventing it from polluting large areas of land and water were seldom described.
- (b) Methods described were usually burial encased in concrete or dumping at sea, although no-one mentioned that the latter is appropriate for low-level waste.
- (c) A few candidates referred to the long lifetime of the fuel resource or low CO₂ emissions but this was, as with other parts of the question, poorly known and answered.

Question 6

- (a)(i) Most candidates knew that this is the Sun.
- (ii) Candidates confuse the use of waves as a source of energy with the use of tides, so some problems stated were inappropriate.
- (b)(i) Few candidates were able to use the formula given to deduce the answer, 8. By substituting numbers into the formula, the answer is easily obtained. For example, if $v = 1$ and $l = 1$, $P = \text{constant} \times 1$. If the wind speed doubles, i.e. $v = 2$, $P = \text{constant} \times 2^3 \times 1 = \text{constant} \times 8$.
- (ii) There were some good answers referring to the spacing of the turbines and the space available, their height in relation to visual impact and the strength of material used.

Question 7

- (a) Candidates were aware of the gravitational effects of the Moon and Sun in generating tides. Some also mentioned Coriolis force.
- (b) Again, there was confusion about the effects of using waves and tides for electricity generation. Some candidates seem to think that the two are interchangeable. However, there were some good answers, mentioning the effects on fish migrations, on coastal habitats and on water quality where estuarial flushing is restricted.

Question 8

- (a) Candidates did not know what geothermal energy is. They should be aware that it is produced from molten rock within 10 km of the Earth's surface.
- (b) Although the source of energy was so badly described, there seemed to be more knowledge here and descriptions of extracting hot water or steam by pumping cold water down to the hot rock were often given.
- (c) As the source of the energy was not generally well understood, candidates were not often aware that the regions where conditions would allow this form of energy could be utilised are relatively infrequent.

Question 9

- (a) There were some very good accounts of harnessing solar energy, from using it to dry crops and passive use in aspects of building design to descriptions of solar panels and photo-voltaic cells. Candidates should try to use appropriate scientific terminology. A black surface *absorbs* heat, describing it as 'trapping heat' is not acceptable at this level.
- (b) This was less clearly answered. Costs were frequently mentioned but references to low maintenance could also have been made. Some candidates introduced the idea of there being no need for power distribution but could have linked this more plainly to the effect this would have on need for infrastructure and the isolated nature of many dwellings in developing regions. Few considered the benefits of low environmental impact.

*Option 2***Question 10**

- (a)(i) Most candidates attempting this option were able to interpret the photographs and state that the lake had become smaller. However, two marks were available here and candidates should realise that a fuller answer is required. Some indication of the extent of shrinkage of the lake area (by about half) could have been given.
- (ii) Most candidates realised salinity would increase.
- (iii) The effect of wind erosion was understood by most candidates.
- (b) Most candidates understood that the increased salinity would mean conditions that existing species could not survive. Few were able to make more points than this, however, with very few suggesting that a smaller area would support less fish or would lead to over-fishing.

Question 11

- (i) Details of water treatment seemed unknown to most candidates, with little or no detail of reasons for or methods of coagulation.
- (ii) Candidates could give virtually no account of the sand filtration process in water treatment. Candidates must ensure that they have covered all areas of the option that they are attempting in sufficient detail.
- (iii) Most candidates knew that chlorination is to kill pathogens remaining in water. Unfortunately this item counted for a single mark so performance on this question, as a whole, was very poor.

Question 12

- (a) *Hydrothermal deposition* was not well known or described clearly. Details of precipitation, such as hot water solutions in-filling rock fissures, were needed for full marks.
- (b) Again, definitions lacked clarity or were simply wrong. Lack of knowledge of the term *placer deposit* has been noted in previous examinations. Again, candidates need to ensure that they have a good knowledge of all areas of the option that they study. Some areas, such as this one, seem to indicate lack of coverage year on year.
- (c)(i) *Bulk materials* is another definition that was clearly unfamiliar to most candidates. These are defined as 'non-metallic raw materials, mined or quarried and used in very large quantities.'
- (ii) The major use of these substances, as bulk materials, is in construction, of roads and buildings, as well as other industries which candidates may specify. Candidates must read questions carefully – this one required a different use for each example given.
- (iii) With such poor understanding of the nature of bulk materials, it was inevitable that there would be few correct answers relating to their extraction. 'Habitat destruction' was the commonest correct answer but the effects of noise and dust, for example could also have been mentioned.

Question 13

- (a)(i) Most candidates correctly identified the soil as acidic.
- (ii) Candidates, who had correctly answered (i), also knew that pH would be increased.
- (b) Candidates were able to interpret the diagram which shows nutrients becoming more available as soil acidity is reduced and most were able to indicate how this would affect crops.
- (c) Most candidates were aware of the importance of root nodules containing nitrogen-fixing bacteria in legumes that help to increase nitrate levels in soil. This entire question was generally well known and answered.

Question 14

- (a)(i) Most candidates correctly defined *salinisation*.
- (ii) High evaporation rates in high temperatures, drawing water with dissolved salts upwards, was often well-described.
- (iii) Many candidates gave good answers, referring to and then explaining the effects of osmosis.
- (b) Candidates were not able to provide an explanation here. The possible effect of irrigation on the water table was the answer looked for.

Question 15

- (a) There was a disappointing lack of knowledge about nuclear waste storage. There were few details in accounts, which indicated problems with a dangerous material but could give no further information. The difficulties of monitoring a long-term hazard and the dangers associated with methods of disposal, including accidents and security risks, were among points that could have been made.
- (b) Again, arguments here were very vague, with candidates appearing to have little knowledge on which to base their answers. Details linked to the saving of finite resources, problems of pollution related to landfill and incineration and questions of whether re-cycling is always energy efficient were amongst points that could have been made.

Option 3

Question 16

- (a)(i) Most candidates gave the correct answer – DNA.
- (ii) The main advantage – reducing herbicide use – did not seem to be appreciated but the appearance of herbicide resistant weeds, following cross-breeding with genetically modified crops, was understood as a disadvantage.
- (b)(i) A few candidates confused *artificial selection* or *selective breeding* with ‘natural selection’.
- (ii) Those who confused (i) with natural selection gave inappropriate answers, referring to evolution. Candidates who gained marks referred to the deliberate selection of animals (or plants) with desirable characteristics that are then deliberately cross-bred but did not explain clearly the difference between this and genetic engineering, as shown. This is that there is no removal of genetic material or use of a vector.

Question 17

- (a) Some candidates assumed the use of the word ‘traditional’ referred to the use of relatively primitive, animal-powered implements rather than the general method of tillage involving several machines and passes over the soil. Advantages looked for involved the use of a single machine, using minimum tillage. There was a better appreciation of the disadvantages, mostly relating to the reliance on herbicides.
- (b)(i) Candidates used the data to state that the crop increased.
- (ii) There was recognition that competition from the vegetation would be the cause of lower yield.
- (iii) This was quite well answered, with references to bare soil encouraging erosion but very few made the point that the crop yield was almost as good with selective application as with blanket application, something that would be considered when weighing up the advantages or disadvantages. This is an occasion when candidates could make better use of data provided in their answers.

Question 18

- (a)(i) ‘Renewable’ was the obvious answer here but other answers could have referred to environmental impact and vegetation as a carbon sink.
- (ii) Only a few candidates realised the problems of the large areas of land needed or the problems that monocropping might bring.
- (b) This was well answered, with references to erosion as an effect of deforestation, as well as loss of carbon sinks and habitat destruction.
- (c)(i) Although not always clearly explained, candidates understood the importance of cattle dung as a source of soil nutrients and also as a means of improving soil structure, so leaching would be reduced.
- (ii) Some detail, of the way in which organic matter binds soil particles and its effects on drainage and erosion, was needed here.

Question 19

- (a) Most candidates gave ‘milk’ as the answer, although wool would also have been accepted.
- (b) Many candidates did not realise the difference between a more primitive hunter/gatherer existence and a more settled form of agriculture that would result from domestication of animals. There were, however, some excellent answers that brought in ideas from an earlier question, suggesting that selective breeding could be practised to produce better, more productive animals.
- (c)(i) A few confused over- and under-stocking but generally answers were correct.
- (ii) The effects of overstocking were well known and clearly stated.

Question 20

- (a)(i) Good answers gave an accurate definition of *maximum sustainable yield* as the amount of fish removed that does not cause a decline in stocks.
- (ii) Some candidates were confused by the graph and seemed to think that effort declined with yield but there were some very good answers describing the trend shown correctly.
- (b) Most candidates were able to state an appropriate measure, such as catch quotas or mesh size restrictions.
- (c)(i) Many candidates suggested that this could help conserve wild stocks. The production of large amounts of relatively cheap protein was another correct answer seen on some scripts.
- (ii) Pollution leading to eutrophication was generally recognised as a potential problem, as was damage to habitats but the possible effects of contamination from drugs used in fish farming and the dangers to wild species of escaped farm fish did not seem to be known.

Question 21

- (a) There were some very good answers to this section. Some candidates could give more detail, for instance when mentioning loss of habitat, an example could be given. Having said that, there were a number of candidates whose answers made good use of examples throughout and who seemed to have a real awareness of this issue. Points that were not often seen were loss of diversity, which would then have a serious effect on food chains and webs and consequently be a factor in endangering a species.
- (b) Again, there were some excellent answers and many candidates made particularly good use of examples in illustrating points, being able to refer to specific captive breeding programmes, collaborations between zoos and other wildlife organisations as well as showing a good knowledge of existing seed and gene banks.

<p>Paper 8290/03</p>

<p>Individual Research Report</p>
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General comments

This November session of the Environmental Science examination had an entry from Centres in Nepal, Finland, Argentina and Zimbabwe. It is to the credit of the Centres and their candidates that this year's entry produced good quality research reports and an overall standard similar to previous sessions. Candidates had chosen topics in which they had a strong interest and it is quite obvious that the research and the writing of reports were undertaken with commendable enthusiasm. Unlike previous sessions, topics were mainly developed around the physical environment and included: pollution of rivers, sea and land, ecology, soil erosion, weather patterns and climatic change.

Although there is much upon which to complement it is a pity that a significant number of candidates either plagiarised or directly copied from Internet sources. Some reports contained a preamble derived from secondary sources (mainly internet) of about two-thirds the report length, leaving little space for research, data collection, description and evaluation; a very small number of reports were entirely based on Internet information. Examiners would refer candidates to the instructions given in the Environmental Science Syllabus (page 26) where the following statements appear related to the Research Report;

- related to the candidate's first-hand investigation
- a hypothesis should be set which can then be tested using laboratory experiments or field work
- general accounts of a descriptive nature of areas or places under numerous conventional headings (geology, population soil etc.) are not acceptable.

Comments on specific assessment criteria**Research and planning [C1]**

This session many reports lacked the clarity that can be obtained through the establishment of a clear hypothesis or principle. It was almost as though many lost sight of the need to provide such a succinct statement right at the start of the report. Although some projects did contain a clearly stated question or hypothesis many provided a broad list of aims and objectives loosely tied to a general title e.g. 'River Pollution'.

The remaining criteria in C1 showed some variation in quality. Investigative methods in the spirit of the examination, often comprise Laboratory experiments over a short or extended period (e.g. soils and plant growth) or field analysis, which can include questionnaire, slope measurement, river flow, pH recordings or frequency observations. Whilst there is nothing wrong in listing the methods to be used, it is important that the methods are explained and justified. This task is better undertaken as a separate section immediately after the introduction so that both the researcher and reader can clearly see where the project is going. If Skills C1 a, b, c and d are unclear then it is difficult to see whether the developed plan is effective at testing the hypothesis.

Data collection and planning [C2]

Whilst there was a large number of candidates who achieved well in this criterion, overall this proved to be the weakest section. Over-reliance upon secondary information, often Internet derived, plus the adoption of very broad topics often precluded laboratory research or fieldwork. Therefore, some projects lacked the necessary data collection, data collation and presentation needed to achieve high marks. It is also difficult to use suitable statistical tools if first hand data is missing or too brief. The need for data collection and presentation is always emphasised within the Examiners comments on the Outline Proposal Form.

Those candidates who did well in this section had clearly used the assessment criteria and combined field observations with laboratory work. In these cases data was clearly represented through graphs, tables, field sketches and photographs. Significantly the narrower the area of study i.e. local or laboratory, the better the data. Although nearest neighbour analysis appeared in some of the ecology based studies, there were fewer examples of the use of statistical techniques such as rank correlation and chi-squared. It is important to remember that such tests serve to verify and evaluate results and that both the statistical technique and its result need explanation and justification.

Conclusions and evaluation [C3]

With most investigations revolving around the impact of human activity upon the physical environment this assessment criteria proved to be the most successful feature of many projects. Candidates used their conclusions to raise issues from their research as well as explain and verify trends in their findings. The better reports attempted a clear evaluation of the research with reference to both negative and positive features of their methodology and results. More often than not, critical evaluative statements were supported by alternative techniques and therefore satisfied criterion C3 (b).

Although criteria (c), (d) and (e) were of a high standard it is important that candidates refer back to their data as stated in (d) 'Full conclusions are drawn, supported by reference to the data'.

Conclusion

Most Centres are now aware of the syllabus changes that affect the examinations in 2005. The new Environmental Management Paper (8291) will still require the submission of a short investigative report. Rather than being concerned with topics that derive from Environmental Science they should in future contain a stronger emphasis on environmental management. It is important that candidates realise that their report should not exceed 2000 words and its theme should be derived from the syllabus content. Within this constraint it should still be possible to produce:

- a report which divides into:
 - an introduction developed around a clearly stated hypothesis
 - a methods section that outlines a project plan and its techniques, fully explained and justified
 - a results section in which data is presented, describe and explained
 - and a conclusion followed by some evaluative comments
- closer adherence to the recommended wordage i.e. 2000 words
- first hand investigation via laboratory research or fieldwork supported by secondary data rather than the other way round.

Examiners would like to extend their personal thanks to Centres for both the quality of their reports and the high standards of Centre based assessment.