CONTENTS

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

This Paper attracted candidates of quite wide global distribution. Although the Paper was of the same level of difficulty as in previous sessions, there was a pleasing improvement in both the quality and presentation of written answers. Short answer questions were generally succinctly answered and longer answers well written; in both cases using correct technical vocabulary. Standards were higher than in previous sessions.

Unlike previous examinations, answers did not polarise into good and bad sections. Candidates were able to access all eight questions and variations in quality often appeared within questions rather than between them. There were very few poor quality scripts and a significant number of candidates achieved marks of over 60%.

Comments on individual questions

Question 1

This question was moderately well answered with marks ranging between 6 and 10 out of the 12 available. Candidates were more comfortable with parts **(d)** and **(e)** than **(a)**, **(b)** and **(c)**. The early parts of this question questioned a knowledge and understanding of seismic waves and how they provide evidence of variations in density from the crust to the core. Whilst there were some good descriptive responses to the data many candidates were unclear about the characteristics of 'p' and 's' waves and the composition of the various layers of the earth.

There were some very good descriptions and explanations of the mechanisms of plate movement. Both sea floor spreading and continental drift were well understood and candidates accurately linked these processes with tectonic activity at the plate boundaries. A few candidates provided excellent answers and contributed information on Palaeomagnetism.

Question 2

This question revolved around soil classification and the processes operating within soils leading up to characteristics of a soil profile. Very few candidates made a correct interpretation of the triangular graph which is in fact commonly used to classify soil sediment; clay, silt and sand being positioned incorrectly. Understanding of the biotic and abiotic components of soils was well demonstrated and the majority of candidates coped well with eluviation and illuviation in a moist tropical climate. Once again in the latter parts of this question, descriptions were better than explanations.

The final section on soil fertility required reference to both leaching and rapid nutrient cycling in order to account for soil infertility; some mentioned leaching.

Question 3

For the majority of candidates this proved to be the most difficult section of the Paper with only part **(a)** eliciting accurate answers. Many candidates did not pay to attention to the detail of the question, which stated that the cities are at the same latitude in the southern hemisphere. Only a very small number recognised that the cities were located in tropical east and west coast areas. This misinterpretation led to very vague and inaccurate explanations of the climate of the two cities.

Tropical east coast places receive moist air from the summer trade winds and maintain a temperature regime consistent with tropical climates. Tropical west coast climates experience cool dry onshore air, which has crossed over a cold ocean current.

Question 4

This question was answered reasonably well by the majority of candidates. Although the structural components of the atmosphere were clearly understood, many failed to link these atmospheric zones with their components and density e.g. stratospheric ozone actually heats the atmosphere, thus an increase in temperatures above 19 km.

Although there were few problems with the latter part of this question, some candidates still confuse global warming with ozone depletion.

Question 5

This question was well answered with good responses to parts **(b)** through to **(e)**. The main fault with part **(a)** was the tendency for many candidates to repeat the question; candidates either found electromagnetic radiation difficult to explain or did not understand it.

Question 6

It was pleasing that nearly all candidates expressed a good understanding of ecological processes and found few difficulties with food webs, photosynthesis, and trophic levels. A significant number of candidates achieved full marks for this question.

Question 7

The demography question was also very well answered, with a significant number of candidates achieving high marks. The Demographic Transition Model in part **(a)** received many accurate interpretations with stage 2 being the developing nation and stage 4 the developed nation. It is worth remembering that stage 1 is in fact quite rare and describes an undeveloped nation or society. Although the remainder of the question was well answered a small number of part **(d)** answers did not deal with factors which have hindered the regulation of the birth rate by family planning i.e. why has family planning proven to be unsuccessful?

Question 8

Parts **(a)** and **(c)** of this question were very well answered with the water cycle diagram being correctly interpreted and reasons for increases in surface runoff being clearly explained. In part **(b)** too many candidates dwelt for too long upon how convection and evapotranspiration contribute water vapour to the atmosphere. The processes leading to the formation of rain were often ignored. There some loose references to convectional rainfall and only one mention of orographic or relief rainfall.

Conclusion

Overall responses to this Paper were better than in previous sessions. Not only was there an increase in entry but the quality of answers was better. Candidates revealed a good understanding of a wide range of environmental processes and expressed themselves clearly and succinctly. Candidates used their time well and managed to complete all parts of the Paper. Examiners found it most encouraging that candidates appear to approach environmental science with a high degree of enthusiasm.

Paper 8290/02

Paper 2

General comments

There was a wide range of attainment shown by candidates for this Paper but it was pleasing to see some excellent scripts, where candidates clearly had a good knowledge of the subject in the sort of detail expected at this level. The extended answer, at the end of each option showed a marked improvement on previous years. In the past this has often contained vague generalisations about ethics, ecology and the environment with little factual content or relevance to the question set. In this session answers were generally relevant and showed good factual knowledge of the subject. A reluctance to apply knowledge to new situations or to solve problems continues to be a weakness, however and candidates must read questions carefully to ensure that they answer the question set. The number of marks available for an answer and the amount of space for writing should give an indication of the detail that is required.

Comments on specific questions

Section A

Question 1

(a) This was generally well known and the labels **(i)**, **(ii)** and **(iii)** were correctly positioned.

(b) This was less well answered with few candidates gaining full marks. Examples of igneous and sedimentary rocks were generally correct but the origin and an example of a metamorphic rock together with the origin of sedimentary rock were not correctly stated. An indication of organic remains or eroded particles of other rocks or minerals was required for the latter. 'Deposited sediment' required an indication of where the sediment came from.

Question 2

(a) Most candidates realised that **Z** represented visible light.

(b)(i) Most candidates correctly drew gamma rays with a shorter wavelength than that shown in Fig. 2.2.

(ii) Again the answer here was generally correct with radio waves shown to have a longer wavelength.

(c) Generally, candidates understood that the wavelength would decrease.

(d) A correct answer here required an indication of absorption of these rays by the atmosphere. 'The ozone layer prevents them from reaching the Earth' is insufficient as it does little more than re-iterate the question.

(e) Some candidates described the temperature distribution but did not explain it, which was what the question required. Few candidates thought carefully about the effects that the different surfaces in a city centre and its more rural environs would have. The idea of close-packed buildings 'trapping' radiation was often noted by those who made good use of cues in the diagrams. No-one, however, considered the effects of urban air pollution from traffic and industry or the effects that industrial processes and heating systems might have on temperature.

Question 3

Some candidates failed to pick up the cues of high CO_2 concentration and lack of ozone related to the greenhouse effect and absorption of harmful U.V. radiation, respectively, but where candidates did understand this, answers were excellent.

Section B

Option 1

Question 4

(a)(i) Candidates were generally able to identify **X** and **Y** correctly as 'gas' and 'oil' respectively.

(ii) **A** was 'impermeable' and **B** 'permeable', both correct answers being required for the mark.

(b) The formation of oil from the decomposition of plankton was the extent of the detail in some answers. Reference to conditions of formation, geological time scale and migration from source to reservoir should all have been included. The number of marks available was shown as five, which should have indicated the degree of detail required.

Question 5

(a) Candidates were able to interpret the pie charts but their answers did not always make it clear to which chart they were referring for specific points. The question required that all charts should be used when answering but it was not always clear whether candidates had done this.

(b) The arithmetic was simple here and most candidates were able to give the correct answer:
17% + 26% + 32% = 75%.
Errors were usually due to not identifying the three fossil fuels, oil, gas and coal.

(c) Most candidates gave the correct order of magnitude, x 10 to x 12 being accepted.

(d) Answers concentrated on the industrial uses of biomass and its limitations and correct points referring to cost and availability were made but candidates seemed less aware of the importance of wood as a domestic fuel in developing countries.

Question 6

(a) Candidates tend to cite 'cheapness' as a universal advantage in answers. This is frequently not valid and should only be used where some detail, explaining why this is likely, can be given. The idea of a renewable resource, which is also less polluting in use than oil, is the obvious significant advantage.

(b)(i) Some candidates misread the graph, describing a slope up as an increase in pH.

(ii) Generally candidates realised that the significant decrease in pH began when industrialisation became important, leading to increased production of SO_2 and hence increased deposition of acid rain. However, the date of this, clear from the graph as the mid- to late-1800s, was not always correctly identified.

Question 7

There were some excellent answers, gaining full marks, for this question.

(a)(i) The correct answer was *nuclear fission*. This was the answer generally given but 'splitting the atom' was also accepted.

(ii) The answer, 'uranium', was generally given correctly.

(b)(i) Most candidates could identify **D** as a neutron.

(ii) **E** is a nucleus. Candidates who were less sure of this topic could not identify this, with 'atom' and 'electron' amongst the incorrect answers.

(c) It was necessary for candidates to understand the reaction to gain marks here, explaining that neutrons bombarding a uranium atom would result in splitting the atom, generating more neutrons which would split more atoms and so on. There were some excellent answers but some candidates could only state that the reaction, once started, could not be stopped. This was insufficient and gained no marks.

(d) There were clear explanations that the heat generated by fission can be used to produce steam that turns turbines. The general principle seemed to be well understood.

(e) Most candidates were well aware of the problems of nuclear power, from the difficulties of disposing of nuclear waste to the risks posed by terrorism. Where *one* reason is asked for, candidates should refrain from giving a list but ensure that they give a single, clear, well-made point as Examiners will not pick a correct answer from a list but will take the first offered. Two lines for the answer suggests that a little more than a one-word response is required.

Question 8

(a) Candidates had no problems in naming suitable sources of renewable energy.

(b)(c) There were many rather vague references to pollution and cheapness but candidates did not make clear how these related to the source named. A number of candidates gave the same answer for each source so that 'no pollution' was all that appeared in the advantage boxes. An example of a good answer was where tidal power was mentioned, with the advantage given as no CO_2 or SO_2 emissions and the disadvantage as environmental damage to habitats caused by the construction of the tidal barrage.

Question 9

There were some excellent essays, gaining maximum marks but some candidates were unable to give sufficient accurate detail

(a) The use of dams and tidal barrages were the usual ways mentioned but some candidates also mentioned wave power, although detail was often either lacking or inaccurate. A few candidates described heating water using geothermal power. This was not relevant to the question and gained no marks.

(b) As in the previous question, many accounts merely mentioned pollution, cost and renewability with no detail as to how these were related to the sources of energy described. The best answers, however, contained detailed comment on environmental and ecological damage and how this is caused together with advantages such as the other uses of reservoirs for leisure use and as a water supply, for example. Such answers also contained reference to the reliability of tides and the difficulties of bringing power generated ashore.

Option 2

Question 10

(a) The calculation was straightforward and most candidates gained both marks.
100% - (43 + 25)% = 32%

(b) Candidates showed understanding of the conditions that would affect **(i)** evapotranspiration, **(ii)** surface run-off and **(iii)** groundwater, highlighting the effects of the amount of vegetation and the nature of the ground surface.

Question 11

(a) Few candidates appeared to realise that the outfall would be positioned upstream of the fall in oxygen level so that **(i)(A)** should have been marked before this. More were aware that **(ii)(B)** would be between the drop and the rise in oxygen levels.

(b) Most candidates did appear to understand the general principle underlying the data provided and gave the correct answer – *eutrophication*.

(c) Definitions here were a little muddled in some cases, especially with reference to the action of aerobic bacteria on dead plant material. Some candidates seemed to think that the living plants used up the oxygen.

(d) The clue to the answer was in the question, where it was stated that the outfall drain originated on farmland. This should have led candidates to realise that run-off from animal waste or fertiliser would be a likely cause but few made this link or gave other plausible answers. This was an example of candidates' reluctance to apply knowledge to a problem-solving situation rather than simply state recalled facts.

Question 12

(a) The answers were: **A** – sand, **B** – silt, **C** – clay.

(b) Adding lime to an acidic soil would raise its pH but would not necessarily make it alkaline, as some candidates suggested. Some candidates who had identified this as a clay soil also mentioned the flocculation of particles on the addition of lime, an alternative correct response.

(c)(i) The answer expected was 'nitrogen'.

(ii) The responses were poor, with quite a number of candidates unable to give an answer at all. There seemed to be little understanding of the fact that manure is organic matter and could be beneficial in improving soil structure. The idea that the mineral content of synthetic fertiliser would be known was better understood.

(iii) The action of nitrogen-fixing bacteria was known but their location, in the root nodules of legumes, was less often mentioned. This was needed for a detailed answer that would gain full marks.

Question 13

(a) Candidates were asked to **describe** changes. Simply stating that waste **(i)** increased, **(ii)** increased, **(iii)** decreased was insufficient for three marks. Some indication of the magnitude of each change should have been given. Candidates are expected to make full use of the data provided.

(b) Reasons given were rather vague. 'Utilisation of paper has increased' needs an indication of why, for example an increase in the use of packaging.

(c)(i) The commonest correct answer was 're-cycling'.

(ii) Again, reasons were often not detailed enough. 'Reducing pollution' or 'saving land' need to be qualified by references to the nature of the pollution or the demands of landfill on land usage.

Question 14

Questions on this topic have been badly answered on past papers and this has continued with the candidates for this Paper. Many candidates seem to have no knowledge of nature of bulk materials or of their extraction.

(a)(i) Many candidates were unable to define a *bulk material*. The answer expected is that it is a non-metallic material needed in large quantities.

(ii) A few candidates were able to complete the first column correctly as 'sand', 'granite' and 'limestone' but the uses of these materials did not appear to be familiar to them.

(b)(i) Most candidates failed to realise that the quarry would fill with water.

(ii) Many candidates did not attempt an answer. There were a few good answers referring to possible uses as a wild-life habitat or as a lake for leisure use.

Question 15

(a) The ideas of multi-flash distillation and reverse osmosis were known but accurate detail was often missing. There were, however a few excellent answers which gained full marks. Some candidates either misread or misunderstood the question and described water purification treatments, removing bacteria and other pollutants.

(b) There were some candidates who clearly lacked any knowledge of the use of fluoride in drinking water but there were many good answers detailing its effects on tooth enamel and health. Its disadvantages were mentioned by some but the ethics of compulsory medication did not figure in any answer.

Option 3

Question 16

(a)(i) Most candidates identified **A** correctly as DNA and **B** as a protein or polypeptide but a few identified **B** as t-RNA or m-RNA.

(ii) Explanations given indicated that many candidates were less than confident in describing the biological detail of this process. The idea that a triplet code is for a single amino acid was generally understood but candidates were unable to explain clearly how this translates into determining the amino acid sequence making a specific protein.

(b)(i) *Genetic modification* was confused with *artificial selection* in some cases. Other candidates mentioned genetic engineering but could give no indication of what this involved. A good answer needed to indicate the non-natural transfer of genetic material from one species to another.

(ii) Few candidates could indicate a method.

(iii) Few marks were gained here. As with other questions, candidates seemed reluctant or unable to apply learned facts to a new situation. Some candidates were able to suggest that biodegradable plastic would reduce pollution but none mentioned conservation of finite oil resources. Few candidates gave a disadvantage – reference to the problems of mono-cropping and the very large areas needed for this fuel source to be viable could have been mentioned.

Question 17

(a) Candidates realised that cultivated land could be bare after harvest and so vulnerable to erosion but many were unable to find a second point. A number referred to depletion of soil minerals but this would not, in itself, result in erosion. The candidates who gave a second valid point commented that constant cultivation would result in loosening of soil and one candidate pointed out that the roots of crops were likely to be less dense and, therefore, less effective at binding the soil than those of permanent vegetation.

(b) Suggestions for methods of preventing erosion were rather limited, many candidates giving only one valid example. 'Plant grass' is insufficient, needing some qualification to indicate circumstances in which this might be done.

(c) Again, marks were restricted, as many candidates had only given one method in **(b)**. However, those descriptions that were given were generally satisfactory.

Question 18

(a) The calculation was carried out correctly by most candidates.
(60 000 + 300 + 8000) – (4000 + 5000) = 59 300 tonnes
Candidates should remember to state units.

(b)(i) Most candidates realised that species **A** would be most at risk.

(ii) Candidates struggled to explain the reason clearly. The proportion of the original mass that remained at the end of the year was the significant factor.

(c) There were good descriptions of restriction of mesh size, quotas, catching season and number of days for fishing and so on. Each control stated needed some description to gain full marks – generally this was well answered.

Question 19

(a) Most candidates gained a mark with the idea of overgrazing but the best answers expanded on this to indicate the reason (overstocking) and the consequences (damage to grass, bare soil and erosion).

(b) This was generally well-known with good accounts of deforestation and its consequences.

Question 20

(a) The advantage of irrigation was often stated as 'plants have enough water to grow'. This is not sufficient for a mark. Good answers mentioned such factors as an extended growing season or higher crop yield. Candidates seemed more aware of disadvantages, particularly *salinisation*. Candidates should avoid one-word answers, particularly 'cost'. To be valid, the nature of the cost involved should be indicated together with an indication that this would not be justified by returns in additional yield, for example.

(b) 'More crop yield' was the commonest correct answer. 'So crops grow quicker' was not acceptable. Again, the disadvantages were described better, with eutrophication of lakes and rivers, caused by leaching of readily soluble fertiliser, frequently outlined. There were also good references to the effects on soil structure with long-term use and the comparison with organic manure.

(c) Some candidates referred to creation of new species but selective breeding is about producing new varieties of the same species. Only a few candidates could give a disadvantage, generally related to loss of genetic diversity.

(d) The commonest correct advantage referred to reduced crop losses. Disadvantages here were well-known, with ideas of pesticide resistance and loss of beneficial insects being frequently mentioned.

Question 21

(a) Most answers concentrated on loss of habitats and the effects of poaching and hunting. A little more detail of the causes (examples of commercial pressures could be given) and consequences (isolation of populations and the genetic effects) was needed for a full answer.

(b) This section was often very well answered, with candidates mentioning laws controlling hunting and outlining the importance of national parks, zoos and botanic gardens, gene banks etc. There were no references to CITES or other named protocols. Candidates should try to give specific examples where possible. This also applies to using examples of endangered species, perhaps where a captive breeding programme has been used. Answers did tend to concentrate on animals. Candidates should remember to include examples of endangered plant species, where collecting for commercial reasons may be involved, for example.

Paper 8290/03

Individual Research Report

General comments

This session had an increased entry containing Centres from Nepal, Finland, Argentina and Zimbabwe. It is to the credit of the Centres and their candidates that this year saw a wide range of generally good quality research reports. 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. Topics were developed on both the human and physical environments and included: deforestation, soil erosion, river and ocean pollution, weather patterns and climatic change, drainage and refugees issues. Notably, even though one candidate researched Mars as an inhospitable environment (without field work!) all topics fell well within the confines of the Syllabus.

Although there is much upon which to complement candidates it is a pity that for a significant number and to a varied extent, internet information has replaced field or laboratory investigation. Some reports contained a preamble derived from secondary sources (mainly internet) of about two-thirds the reports 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 specification (page 27) where the following statements appear:

- the basis of the study should be 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)

There were few problems with the establishment of a clear hypothesis or principle. The majority of candidates made these as emboldened sentences followed by extensive elaboration, thus high marks were achieved in criteria (a) and (b).

The remaining criteria showed a wide 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. In fact much successful research and subsequent reports will have completed this part prior to the first hand investigation. Examiners are sure that marks for assessment criteria (c), (d) and (e) would be consistently high if this were done.

Data collection and planning (C2)

Overall this proved to be the weakest section for a significant number of candidates. 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.

There were of course a large number of candidates who achieved well in this criterion. This session they had mainly opted for field investigations involving questionnaires and measurements of slopes, drainage, water pollution and biodiversity. 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. A small number of candidates used quite sophisticated statistical tests (variance, matched pairs, student 't' test as well as the more traditional chi-squared test and spearman rank correlation. 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)

This proved to be the most successful feature of the majority of projects, and was generally very well done. Candidates used their conclusions to raise issues from their research as well as explain and verify trends in their findings. Most attempted a clear evaluation of their research with reference to both negative and positive features of their methodology and results. Very few candidates offered simplistic criticisms such as "I did not have enough time" or "the equipment did not work properly". Instead, there were good quality evaluations of such things as site, questionnaire response, availability of data and even self-criticism. One should regard positive evaluations such as these, as worthy of credit. Criterion (b) is more difficult as candidates are expected to offer modifications to their methods and formed the weakest part of assessment criterion (C3).

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

As stated before it is pleasing that entry into this examination has increased and that candidates have taken on board the structure of scientific method. The important points that need to be taken on board for the future are structural:

- a report which divides into:
  - an introduction developed around a clearly stated hypothesis
  - a methods section which outlines a project plan and its techniques, fully explained and justified
  - a results section in which data is presented, described and explained
  - and a conclusion followed by some evaluative comments.
- closer adherence to the recommended wordage i.e. 4000 words
- first hand investigation via laboratory research or fieldwork supported by secondary data rather than the other way round.

Examiners would like to extend personal thanks to all Centres for both the quality of the reports and the high standards of Centre Based Assessment.