ENVIRONMENTAL SCIENCE

GCE Advanced Subsidiary Level

Paper 8290/01

Paper 1

General comments

Few candidates seemed to have a comprehensive knowledge of the material covered by the syllabus. None achieved consistently good scores throughout the paper although there were good answers given to individual questions. Questions containing simple mathematics appear to intimidate some candidates, who make no attempt to answer these sections. They should be assured that the arithmetical processes required are kept simple and that it is always worth making an attempt, as marks may be gained for correct method even if the final answer is incorrect. Candidates must read questions carefully and ensure that the response that they make answers the question set. Irrelevant information on a topic will not gain marks.

Comments on specific questions

Question 1

(a) Few candidates were able to correctly match the graphs with the descriptions of the axes. A number of candidates left blanks. As marks are not deducted for incorrect responses, candidates should always attempt an answer. The correct order was 1.1, 1.4, 1.5, 1.6, 1.2 and 1.3.

(b)(i) As the question referred to the Earth's albedo, general definitions of albedo were insufficient. Candidates generally mentioned the reflection or scattering of light by the Earth but needed to include reference to surface or atmosphere for full marks.

(ii) Some candidates thought that increased carbon dioxide levels would increase albedo, linking this, irrelevantly, to the greenhouse effect. There were, however, some good answers, where candidates realised that changes in vegetation cover would have a significant effect. The increase in carbon dioxide concentration could influence a decrease in albedo but no candidates gave any plausible reasons here.

Question 2

(a) Both population curves were sigmoidal this was recognised by most candidates.

(b) Candidates generally recognised that population **B** was growing at a faster rate.

(c) This was a simple calculation but quite a number of candidates made no attempt to answer. The working was: $\frac{(510 - 60)}{6} = 75$ per day.

(A small margin of error reading from the graph was allowed.)

(d) Evidence given should have been drawn from the graphs, as required by the question. Candidates were making general suggestions more appropriate to the answers expected in **(e)**. It was clear, when Figs. 2.1, 2.2 and 2.3 were compared, that the growth rate of both populations decreased when the beetles were kept together, that the maximum population size of each type was smaller and that population **A** began to decline.

(e) Competition and predation were the commonly mentioned factors. Candidates should specify what the beetles were competing for (e.g. food) rather than simply refer to "resources". References to one being more adapted to the conditions than the other does not address the question of how the presence of one type affects the other.

Question 3

(a)(i) "Sedimentary rock is formed by sedimentation" did not gain a mark. Candidates needed to state what formed the sediment and that compression of this then formed the rock.

(ii) Most gave a good explanation of igneous rock.

(iii) Candidates needed to state that **high** pressure or temperature are required to bring about the changes that result in metamorphic rock.

(b)(i)(ii) Sedimentary rocks were identified as 2,3 and 4 - all were needed for a mark to be awarded. 1 was igneous rock.

(c) Candidates mentioned the different distances of **A** and **B** from the cooled magma but generally failed to mention the effect that the heat from the magma would have had, before it cooled.

(d) There were few credible definitions of either a rock (usually no definite chemical composition or made of a number of minerals) or a mineral (a definite chemical composition or crystalline structure).

Question 4

(a)(i)(ii) (iii) Some candidates were unsure about the nature of each type of weathering, confusing biological and physical examples, in particular. Most candidates used "acid rain" as the example of chemical weathering but descriptions of its action were not always clear.

(b) Few candidates could outline differences between weathered rock and soil. The commonest difference mentioned was the presence or absence of humus and a few candidates also mentioned the flora/fauna content but none could give a third difference (such as the lack of different types of soil particle in weathered rock).

(c) Some candidates do not understand the difference between weathering and erosion, so examples of this process were often inappropriate. To simply state "river", "ice" or "wind" for each example merely repeats the question. Some indication of how the chosen example fulfils this function is needed. A number of candidates mentioned the slowing of flow as a river progresses downstream and material being deposited as energy is lost. This was the type of answer required.

Question 5

(a) Most candidates knew that process **B** was evaporation but many stated that **E** was transpiration. This is not sufficiently accurate - the correct response was evapotranspiration.

(b)(i) Most indicated that the Sun is the source of energy.

(ii) There were many correct answers (**B** and **E**) but some candidates appeared to misunderstand the question and named storage zones rather than processes.

(c) As with other calculations, there were some candidates who did not have the confidence to attempt the question. An indication that **E** = **D** - **C**, either in letters or using figures would have gained a mark. The correct answer was then 63 x 1015 kg $year^{-1}$. Units should be shown, in order to gain the mark.

(d) The largest storage zone is the oceans and the smallest is the atmosphere. Both were needed for a mark to be awarded. Whilst most candidates knew the former, fewer knew the latter.

(e) Again, both correct responses were needed for a mark (largest - ice caps/glaciers, smallest rivers/streams). There were fewer correct answers here than in **(d)**.

Question 6

(a) Answers here were generally poor and often did not address the question. Candidates concentrated on the effect that a large area of water might have on temperature generally, giving detail about specific heat capacity, without reference to the mean annual temperature range as the question required. Candidates should also be careful in choice of wording. A "low" temperature range suggests cold temperatures, when what was meant was a small or restricted range.

(b) This was very poorly answered, with many answers doing little more than repeat the question. Temperature related to wind direction, temperature range or humidity, dependant on whether prevailing wind has passed over land or sea were all points that could have been expanded.

(c)(i)(ii) There were very few candidates who could correctly name two currents, some confusing them with winds. There were more correctly labelled warm and cold currents but few gained both marks.

(d) Lack of knowledge of this material was plain again here, as there were few marks gained.

Question 7

(a) This was generally well answered.

(b) Again, most candidates were able to give a good answer here with a suitable choice of storage zone (such as coal, oil and natural gas) linked to an explanation (burning fossil fuels).

(c) This was much less well done with some very confused accounts including references to the depletion of the ozone layer affecting carbon dioxide build-up and references to the greenhouse effect, which were both inaccurate and irrelevant.

(d) Brief definitions of source and sink (loss greater or less than gain respectively) were required here but were seldom seen.

Question 8

(a) Most candidates could state most of these correctly although the major component of the Earth's early atmosphere - water (vapour) or nitrogen accepted - was less well known.

(b)(i)(ii) Very few candidates could explain clearly. Diagrams were not clear and labels were confused. There were many references to high and low pressure and warm and cold fronts but differential heating/cooling of land and sea, with the effects of this producing convection currents which result in onshore and offshore winds, were seldom mentioned.

Question 9

(a)(i)(ii) (iii) This was generally well answered, with **(ii)** (pioneers or colonisers) the least well known.

(b) The idea of an organism making food/complex organic materials from simple inorganic substances was clearly known but not always well-expressed. References to photosynthesis made it clear that candidates understood the term.

(c) This was also well-known, with candidates stating "detritivore" or "decomposer" or giving a suitable example of a type of organism such as bacteria or fungi.

(d) Most candidates suggested that the depth or fertility of the soil would be reasons but few mentioned the effect that trees would have in shading out other flora or in out-competing them for nutrients etc.

(e) There were some good suggestions here, with references to animals eating plants, dispersing fruits and seeds from elsewhere and affecting the fertility of the soil with their waste.

Question 10

(a)(i)-(v) This was well-answered although some candidates were unsure about the meaning of "secondary consumer" and others missed the significance of the **dead** bark in selecting a detritivore/decomposer.

(b) There were some good answers but some candidates referred to the effects of the squirrels on other fauna, rather than the effects on the woodland. Some candidates did not notice, or did not appreciate the significance of, the fact, according to the food web, that the squirrel has no predator.

(c) Most candidates correctly named Fig. 10.3 as the pyramid of biomass but some of these candidates found it hard to explain their reasoning. Candidates who referred to the base of Fig. 10.2 as a single line, consistent with a single organism and therefore matching the food web shown with a single tree, explained more clearly than those who confined their explanations to Fig. 10.3 alone.

(d) Some candidates thought that the energy values could simply be subtracted from each other between trophic levels, when it was necessary to calculate the proportion of energy transferred at each level. Candidates had to show that they had compared the transfer at each level in order to gain one mark and state the most efficient transfer (from level 1 to level 2) for the second. Again, quite a number of candidates did not attempt the section but there were also a good number of clear, accurate answers.

Paper 8290/02

Paper 2

General comments

Many candidates had only a very superficial knowledge of material required by the syllabus. It is assumed that only one option will have been studied, allowing sufficient time for the syllabus content to be covered in depth. If more than one option is studied it is likely that candidates will be unable to answer the questions in sufficient detail to gain many marks. Candidates should use scientific terms and language so that answers are clear and unambiguous.

Comments on specific questions

Section A

Question 1

(a)(i)(ii) Some candidates labelled the boundaries rather than the layers but there were some good answers showing the order from the lowest layer as *troposphere*, *stratosphere*, *mesosphere* and *thermosphere*, with the ozone layer in the stratosphere.

(b)(i) Some candidates omitted details of Earth's atmosphere, making their comparisons incomplete. Again, there were some good answers but candidates should avoid using "thick" or "thin" to describe density or pressure, as this is confused with depth of the atmosphere above the surface of the planet.

(ii) The nature of the atmosphere, in composition and density was again important but some candidates thought that distance from the Sun was the main factor.

Question 2

(a) Few candidates could name the phases of the graph as **A** - lag, **B** - log or exponential, **C** - linear and **D** - stationary.

(b) This was generally well answered. Food supply and predation were usually mentioned here, with a few candidates mentioning nesting sites.

(c) Most candidates suggested two effects, such as competition for a resource with a native species and the collared doves providing additional food for birds of prey. The introduction of disease, to native species by the doves, was also a good suggestion.

Question 3

Answers here were disappointing, with candidates failing to make their answers relevant to the question. Whilst many offered information about the movements of tectonic plates, they did not relate this to the incidence of earthquakes or to the distribution shown on the map.

Section B

There was a fairly even spread of answers over the three options. It is assumed that candidates will have studied only one and that this will have been in some detail. It appeared that this was not necessarily so in some cases.

Option 1

Question 4

(a) Quite a number of candidates mentioned wind and waves but both of these energy sources originate from solar energy.

(b)(i)(ii) Most candidates gave the correct answer - falling water - for the first part of this question but fewer stated that the second energy conversion would be in the house. Many thought that this would occur in the transformer.

(c) Most candidates knew that energy would be lost at each transformation but some development of this point, such as an example, was needed for the second mark .

Question 5

(a)(i) An example that involved reduced fuel consumption was needed here. Many candidates believe, incorrectly, that catalytic converters will reduce carbon dioxide emissions.

(ii) There were good answers here, detailing the possible consequences of an enhanced greenhouse effect. There are some candidates who continue to confuse the depletion of the ozone layer with this, however.

(b)(i) Candidates were generally able to give a simple chemical explanation.

(ii)(iii) The confusion with the effects of carbon dioxide was again apparent here in addition to confusion with stratospheric ozone.

Question 6

(a) Candidates clearly understood the principle here, although answers were not always well expressed. The idea of formation over a long time scale and in conditions no longer found, coupled with rapid depletion of stocks were the points expected.

(b)(i)(ii) (iii) This was very poorly answered. It was clear that candidates did not know the meaning of the term *kerogen*, although this is specified in the syllabus. It is this level of detailed knowledge required in the option studied that is necessary if good marks are to be achieved.

(c) Most candidates knew that rock **A** was impermeable and rock **B** permeable.

Question 7

(a)(i)(ii) Answers here were usually correct as *fission* and *uranium* respectively.

(b) Again, this was well known.

(c) There were good answers here, with candidates mentioning the impact of accidents, problems of storing waste, concerns with terrorism, the environment and health amongst other valid points.

Question 8

(a) Candidates had more knowledge of wind as a source of energy than waves, which was confused with tidal energy generation.

(b)(i)(ii) (iii) Explanations here lacked clarity, suggesting that candidates did not grasp basic scientific principles. Black as an absorber of radiation was understood but the idea that the glass would trap heat was not clear and whilst candidates knew that the insulation would reduce heat loss, some thought that this loss would be to the atmosphere rather than to the house or roof.

Question 9

(a) There were some very good answers here, with detail of formation of acid rain and its effects on flora, fauna, bodies of water and buildings.

(b) This, again, was well answered with candidates showing detailed knowledge. For example, there were references to filters in industrial processes as a preventative measure and the addition of limestone to lakes as a remedy.

Option 2

Question 10

(a) Candidates needed to identify the two rocks as **A** - permeable and **B** - impermeable.

(b) Most candidates correctly marked the water level.

(c) Most candidates knew that the water levels would fall.

(d)(i) Candidates were asked for ways, not sources, here; so *leaching* and *run-off* were looked for.

(ii) Candidates were more familiar with sources of nitrate pollution than phosphate, although fertilisers can contribute to both. Few mentioned detergents as a source of phosphate pollution.

Question 11

Many candidates confuse the processes of drinking water purification and the treatment of sewage.

(a)(i)(ii) The idea of filtration as a slow flow through sand beds was seldom mentioned. Most candidates described screening for large debris, which was inappropriate at the stage shown on the flow diagram. The use of chlorine as a disinfectant was generally known but no further detail was offered.

(b) Accounts here were not very clear although candidates were attempting to explain the fact that some pollutants are not leached deep into the soil and the rock provides a filter.

Question 12

(a) Maximum marks were more or less universal here.

(b) Again, answers were good, with the idea of recycling being uneconomic being common, although some indication of reasons for this (energy input, for example) could have been given.

(c) There were good answers here, with land availability, problems of methane production and pollution by leachate, amongst others, being described. Candidates should note that where *two* problems are required by the question, credit will not be given for listing more. It was expected here that a problem would be stated and then more detail of this problem given.

Question 13

(a) *Eutrophication* was generally described adequately. The effects of enhanced nutrient levels was required. An indication of the source of the nutrients could be mentioned but detail was not required for this definition. Candidates should be able to select relevant information in answering questions.

(b) The idea of dilution, as distance increased from the sewage discharge was seldom mentioned.

(c)(i) Candidates did not appear to understand the term *biological oxygen demand* (BOD), although this is specified in the syllabus. A simple understanding of BOD, as a measure of the quantity of oxygen needed by decomposers in the water, is all that is needed.

(ii) There was further evidence of confusion of water purification and sewage treatment, with few accounts in the correct order or in any detail.

Question 14

(a) Some candidates thought that *podsols* were characteristic of tropical areas but there were some good answers.

(b) Descriptions of the formation of a pan layer lacked precise detail. Whilst leaching was mentioned, most accounts missed the nature of the layer in terms of minerals and its hardness. No account contained information about the conditions of high rainfall, low evaporation and free drainage needed.

Question 15

(a) Again, accounts of mining, quarrying and dredging lacked detail and the different problems associated with the three activities were not made clear. Many candidates tried to bring in irrelevant references to global warming and very little was known about dredging.

(b) Apart from recycling and action to reduce demand, there were few ideas here, with no references to the use of disused quarries for leisure or as wildlife habitats.

Option 3

Question 16

(a) It was expected that candidates would use the definition of species in order to answer this question, using the two examples to illustrate the criteria. However, few were able to do this.

(b)(i)(ii) Reference to genetic material was needed to answer this. Following the general definition candidates should have been able to outline the principles of natural selection by means of an example such as the peppered moth, as stipulated in the syllabus. Few candidates seemed to have this level of scientific knowledge or to be able to use relevant and appropriate scientific terms.

Question 17

(a)(i) The processes at **A** and **B** were *run-off* and *transpiration*, respectively. The question asked for descriptions so that some detail of how these occur or their effects (e.g. run-off from melting snow or transpiration increasing moisture in the air resulting in cloud formation) were needed for full marks.

(ii) The answers here showed a good knowledge of the consequences of deforestation but yet again there were candidates determined to bring in global warming, which was not relevant in the context of the question.

Question 18

(a) Candidates showed little knowledge of the processing of sugar cane to produce fuel. It was expected that the stages of the process would be known in outline as this is specified in the syllabus.

(b) Candidates did not appear to be able to connect the idea of starch as a very common plant storage material with the idea that much more plant material would be usable for the production of fuel. Candidates need to be able to apply knowledge and general principles to problems such as this, as well as simply recalling factual information, in answers.

Question 19

(a)(i)(ii) Candidates answered the first part of the question quite well, realising that if younger fish were being removed by over-fishing that stocks would not be replenished. However, many did not seem to understand the idea of the total allowable catch and were unable to offer any reasons here. Few were able to make any connection between the two figures for each year.

(b) Most candidates were able to answer this in terms of disrupted food chains, showing good understanding of this.

Question 20

(a) Candidates were able to suggest a number of factors, including aspects of climate, topography, soil, markets and culture. This was well answered.

(b) The terms *overstocking* and *overgrazing*, which would have summed up the situation described, were not used often in answers.

(c)(i) Interpretation of the information shown in the diagram was good. Candidates suggested that the quality of the grass would be important in the breeding condition of the animals or in providing good-quality food for young animals.

(ii) Very few candidates were able to give a convincing answer here. One or two realised that animal numbers would increase in good years leading to overgrazing in drought years but this was not developed to include ideas of a drop in animal numbers again which could then lead to famine.

Question 21

(a) Accounts lacked some details here - more use could have been made of examples of endangered species, captive breeding programmes and seed banks, amongst other points. However accounts were generally relevant and candidates showed a good general knowledge.

(b) Candidates were less able to answer this section convincingly. Again there was a lack of appropriate scientific terminology with respect to hybrid vigour and genetic material.

Paper 8290/03

Individual Research Report

General comments

This examination attracted 31 reports from 6 Centres. Even with such a small entry it was pleasing that there was a wide variety of topics incorporating ecological studies, urban environments and soil analyses. It is commendable that Centres and their candidates maintained the generally high standard of previous sessions. Most candidates clearly understood the background to their research themes and their reports revealed a greater input of primary data rather than relying upon secondary information. Nearly all research projects were reliant upon field analyses comprising a variety of valid techniques, which produced results of both a numerical and pictorial (photographic and graphic) nature.

Whilst nearly all reports exhibited division into: an introduction, methods, results and analysis, and a conclusion, it is important to stress that some reports were far too lengthy. This was mainly derived from an over-elaboration of the background to the study. It would have been better to restrict the background to a brief justification of the investigation within the introduction and method sections.

Comments on Individual Research Reports

As in previous years, this section of the report addresses performances within skills **C1**, **C2** and **C3**.

Skill C1

This was generally of a good standard. Although not always expressed as a hypothesis, most candidates clearly understood the principles and theories underpinning their research and were able to provide and justify valid and viable methods of investigation. Most topics were of a sufficiently localised nature as to permit field and laboratory investigation. It was a pleasing feature of this year's reports that nearly all began with a clear statement of intent through either a question, a hypothesis or a statement describing the investigation.

As already stated, many candidates wrote a very lengthy background to their topic. Although these introductory sections provided interesting reading and had received a great deal of attention, it might have been better to have briefly listed these more general and theoretical objectives. The syllabus specification states that reports should be of between 3000 and 4000 words. With this limitation, a balance approximating to: a 300/400 word introduction, 300 words for a justified methodology, 2000/2500 for results and analysis and up to 600/700 words for the conclusion/evaluation might be advisable. It might be useful for Teachers to advise their candidates that Skills **C1** (**(a)** and **(b)**) should be restricted in length; perhaps achievable by combining the hypothesis statement with a brief explanation.

Questionnaires once again proved to be a popular field technique it was good to see that more thought had been given to their construction with results displayed in graphic and descriptive form. The collection of primary data was a central concern of the majority of candidates and the most successful reports were concerned with localised topics such as: water pollution, waste disposal, flooding and local urban environments.

Skill C2

This skill yielded quite high marks in parts '**(a)** to **(d)**' as most candidates presented data derived from primary sources. Information was generally presented in a clear and relevant form. As in previous sessions the most popular techniques used to present data were tables, pie charts and bar graphs. It is important that candidates realise that line graphs should be used with continuous data and bar/pie graphs with discrete data.

Although skill **C2** does require the collection and collation of numerical data for which a variety of graphs and tables are appropriate it is worth noting that supportive material in the form of field sketches and photographs is perfectly valid within skill **C2** parts '**(a)** and **(b)**'.

Although more candidates took on board the use of statistical techniques to verify their data in order to verify the validity of their survey and sample, this skill formed the weakest part of **C2**. Such tests can be used within the concluding sections of the report where some basis for evaluating the research data is needed. It is worth noting that the specification refers to suitable statistical tools used to analyse the data rather than simply present it.

Overall skill **C2** proved to be the strength of the majority of candidates; and the use of a statistical test was certainly a valid refinement for some candidates.

Skill C3

This once again proved to be the weakest part of many reports. The skills associated with the environmental principles (**(c)**, **(d)** and **(e)**) in the research, were moderately well covered; however parts '**(a)** and **(b)**' were often either poorly covered or absent.

It is important that candidates develop a conclusion, which partly reviews the results of the investigation and additionally evaluates its success or degree of failure. A critical evaluation of the chosen methods and the validity of the results will not have a detrimental effect on the quality of the research. In fact, a clear assessment of the data, the limitations of the method and apparatus, supported with suggestions on how the research could have been improved would fully satisfy parts **(a)** and **(b)** of this skill. Please note that unless there are extenuating circumstances 'lack of time' cannot really be regarded as a limitation. Such points could be raised through two final sections titled, conclusion and evaluation.

Conclusion

It was most pleasing that once again candidates took on the true spirit of the environmental science syllabus and opted for issues, which proved worthy of research. To the credit of their Teachers, nearly all candidates showed the benefits of the teaching and instructions they had received, through both the content and structure of their reports.

It is important that the guidelines in the syllabus are closely followed and all Teachers and candidates should refer very closely to the section titled 'Coursework: The Research Report': on page 29 of the 2002 syllabus. The project should deal with issues or an issue on a small or local scale and lend itself to field and laboratory research. Once primary data has been collected, it should be collated and a variety of statistical techniques utilised to present the information. Whilst secondary information will provide useful background to the study it should not be sole focus of the study.

Finally to reiterate a point made previously, candidates might like to adopt the following model for the presentation of their work:

- An introduction with a clearly stated hypothesis.
- An outline of the investigative methods to be used; these should be justified.
- A presentation of results fully described and explained.
- A conclusion/evaluation which: draws together the results; assesses the level of agreement with the central hypothesis; and evaluates both the effectiveness of the investigation and the environmental implications of the topic.