ENVIRONMENTAL MANAGEMENT

Paper 8291/11

Lithosphere and Atmosphere

Key messages

- Adequate preparation for the examination is essential. This includes learning the facts, possessing the necessary skills of analysis and interpretation, and practising on questions from past papers.
- Read questions carefully and, particularly in section **A**, achieve consistency through a set of linked data response questions.
- Ensure you understand the various question instructions, and answer only what is asked. Irrelevant answers, even though correct in themselves, will not gain credit and will waste your valuable time.
- Use the published mark schemes to identify the type of answer, both in content and length, required by different questions. Use the allocated number of marks in the question paper to assist you in constructing your answer.
- Apportion your time sensibly between questions and between Sections **A** and **B**.
- Quote data in tables and graphs in order to support points.

General comments

This paper proved to be an effective test of both knowledge and the ability to analyse a wide variety of data and topical issues. As in previous sessions candidate performance was varied. In this session a significant number of candidates found the data response questions in ***section A*** more difficult than the discursive questions in ***section B***. Like previous examinations candidates found ***section A*** data response questions based on the Lithosphere and Atmosphere topics more difficult than those in the Hydrosphere and Biosphere paper. ***Section B*** questions were better answered. The quality of written English was mostly of a high standard with many of the essays a pleasure to read.

Question 1

Although there were some excellent answers to **Question 1**, many candidates showed a lack of understanding in relating *weathering* and *erosion* in parts **(a)** and **(b)** of the question. The more discursive and analytical part **(c)** was generally quite well answered.

(a) Only a small number of candidates correctly stated the meaning of the two terms. For chemical weathering some credit was achieved through describing the action of acids on rocks; mostly acid rain. Very few mentioned the ultimate dissolving of minerals through processes such as solution, carbonation, hydrolysis and the solubility of some minerals. Only a small number of candidates knew of mechanical weathering and some described it as the action of machinery in breaking up rocks rather than processes such as frost action (freeze-thaw), vegetation or salt.

(b) Questions relating to the photograph of the coastal cliff and slope were generally poorly answered. In part **(iii)** there were some answers that achieved full credit.

(i) The expectation was that candidates would interpret the bedding planes and joints at point **A** as the structural weaknesses along which weathering and erosion would take place. However, the majority of answers either repeated the wording of the question or received minimal credit for describing the cliff face's direct erosion by wind. Most answers had little reference to the processes that are part of the explanation.

(ii) There were two elements to this part. A description that mentioned large rock fragments collecting on the ledge at **B** and at the shoreline, followed by an explanation that mentioned gravity / momentum and the change of gradient at **B** and the shore. Most gained credit for the description.

(iii) This was quite well answered with most answers mentioning how erosion at the base progressively de-stabilised the upper parts of the slope towards point **B** and ultimately the base of the cliff.

(c) Most answers displayed an adequate understanding of the factors that influence slope stability. In both parts descriptions were stronger than explanations.

(i) Descriptions were generally better than explanations in this part. Most descriptions mentioned the relationship between soil loss and vegetation and made good use of the data. Some related explanations outlined the role of roots in binding soil particles, and a small number of candidates received full credit by also mentioning how surface run-off accelerated soil losses.

(ii) Here good answers focussed on the inadequacy of replanting and the use of strip or selective felling. The poorer answers tended to repeat the question.

Question 2

Many candidates found this more accessible than the lithosphere question. Only a minority of candidates showed a full understanding of how to complete the chart and table correctly.

(a) (i) A small number of candidates achieved full credit for placing the letters correctly.

The main issues were:

- not being able to locate the troposphere, tropopause or stratosphere correctly
- not understanding where ozone depletion and global warming occurred

(ii) Some credit was obtained by candidates who outlined how radiation from the surface warmed the lower layers of the atmosphere. Very few mentioned the process of adiabatic cooling.

(iii) It was a requirement of the question to describe the decrease in atmospheric pressure, but very few candidates did this. Most answers did not explain how the weight of air particles and gravity produced the altitudinal decrease in pressure, and the data was rarely used. A small number of candidates gave fully correct answers.

(b) Very few candidates completed each row in the table correctly. General issues were that nitrogen oxides and CFCs were not seen as contributing to both global warming and ozone depletion, and that water vapour is a greenhouse gas and only contributes to global warming.

(c) The majority described the effect of greenhouse gases in the troposphere and the depletion of ozone in the stratosphere. However, a significant number of candidates regarded them as the same process. It might be worth emphasising that a loss of ozone might cause cooling rather than heating.

Section B

The three questions in ***section B*** attracted approximately equal numbers of candidates. Although there were some excellent responses to both part **(a)** and the essay, there were a significant number of poor answers to both parts. Many candidates appeared to find writing essays under examination conditions difficult. Many essays were too short, lacking planning and they frequently suffered from a lack of exemplar material. High quality essays were planned, had a logical structure and incorporated the exemplar material needed; above all they were well written with few errors in spelling, punctuation and grammar. Candidates should be spending about 45 minutes on this section which should give adequate time for essay planning and writing.

Question 3

(a) Most candidates obtained some credit for this part. These were mostly achieved through accurately describing the detail in Fig. 3.1 and the effects of tsunamis. The best part **(a)** answers clearly explained how tsunamis built up their height and strength upon reaching the shallow water of a shore. In referring to wind driven waves very few candidates outlined how hurricanes and storms can produce high destructive waves.

(b) There was a wide range of marks according to ability, but most candidates made a good attempt at this question. Good answers chose recent examples and were well balanced in the description and explanation of the effects of earthquakes. These high quality answers continued to assess a

variety of measures that incorporated prediction, damage prevention and relief. Most of the weaker answers contained relevant examples often focussing on the Japanese or Indonesian tsunami but lacked detail on the broader effects of the earthquake. Other weaker answers contained a mismatch between the example and its effects.

There were plenty of descriptions of appropriate pre- and post-earthquake measures but only a small number of candidates made assessments of their success or limitations.

Question 4

(a) On the whole, this part was well answered. Good responses drew upon the whole range of UAP deaths per million and weaker answers mostly dealt with the top and bottom values. Whilst China and SE Asia formed the focus of most answers, many ignored the very low values for Europe and Africa. Most candidates provided valid reasons and the main discriminator between strong and weak answers lay in the quality of elaboration.

(b) The key to a good answer was where candidates chose and stuck to an urban area with which they were familiar. Whilst relevant as background information, it was not necessary to spend a lot of time describing the causes of air pollution. Instead, as many candidates did, an assessment of improvement measures was needed. Nearly all answers were concerned with measures that targeted the volume rather than the effects of urban pollution.

Weak answers were either too brief or very general with extensive references to rural areas, e.g. the state of Florida.

Question 5

(a) Candidates should be familiar with the model shown in Fig. 5.1. The emphasis in this part was to relate industrial output, resources and pollution to population for the period 1900 to 2100. There were a small number of very thorough analyses that reviewed the whole period in terms of growth and decline. A significant number of candidates only dealt with the period of growth from 1900 to 2025 and therefore lost credit.

The most effective answers used population growth and decline as the central thread about which the other components of the model were addressed. Answers that dealt with each component separately were less effective.

(b) The best answers were well written and evaluative essays that were a pleasure to read. Top quality answers recognised that meeting future needs was a matter of utilising resources and developing agriculture, industry and urban needs as well as managing population size, i.e. future supply and demand. For the most part clear contrasts were drawn between the prospects of MEDCs and LEDCs, and candidates made use of exemplar material.

Weaker answers outlined that MEDCs were better prepared for the future because they are rich and can exploit LEDCs. A common error was to make inaccurate assessment of the level of development of some nations, e.g. Brazil and Mexico both rank in world's top 20 and cannot be regarded as LEDCs.

ENVIRONMENTAL MANAGEMENT

Paper 8291/12

Lithosphere and Atmosphere

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- Use the published mark schemes to identify the type of answer, both in content and length, required by different questions. Use the allocated number of marks in the question paper to assist you in constructing your answer.
- Apportion your time sensibly between questions and between Sections **A** and **B**.
- Quote data in tables and graphs in order to support points.

General comments

Once again there has been a substantial increase in the entry. As in previous sessions, candidate performance was varied. In this session, a significant number of candidates found the data response questions in **Section A** slightly more difficult than the discursive questions in **Section B**. The quality of written English was mostly of a high standard with many of the essays a pleasure to read. There is a need to remind candidates to read questions carefully and, particularly in **Section A**, achieve consistency through a set of linked data response questions. Overall this paper proved to be an effective test of both knowledge and the ability to analyse a wide variety of data and topical issues derived from the atmosphere and lithosphere sections of the syllabus. Like previous examinations, candidates found questions based on the Lithosphere and Atmosphere topics somewhat more difficult than those in the Hydrosphere and Biosphere paper.

Section A

Question 1

This has been the first occasion in which questions on noise have been set. The majority of candidates engaged well with most parts of the question in terms of both data response and analysis. The whole question revolved around noise issues in Berlin.

(a) Fig. 1.1 contained a bar chart displaying the percentage of people affected and strongly affected by different sources of noise in Berlin.

(i) Nearly all answers contained reference to a loud emission of sound and about half recognised that to become a pollutant it had to cause discomfort or stress.

(ii) With a very small number of exceptions an answer in the range 22–24 was given.

(iii) There were few issues with this question. Most answers mentioned the widespread nature of road traffic and the localised nature of air traffic. Altitude was also mentioned as a contributing factor with air traffic.

(iv) It proved slightly more difficult to describe why 1 in 3 people are strongly affected. Living close to an airport or working near to a major road junction were the most popular choices. Weak answers repeated parts of **(iii)**.

(v) This enabled candidates to make assessments about the other elements of Fig. 1.1. It was quite well answered with most achieving between high and full credit. As the question required an assessment of the extent to which people were affected by noise pollution, there was a need to use the data in Fig. 1.1. This proved to be a discriminator between good and moderately good answers as the latter were mostly very general and descriptive without the use of the data.

(b) The vast majority of candidates made good use of the photograph of Berlin and many achieved full credit. Such answers made accurate reference to noisy locations such as: the railway, roads, a construction site, residential areas and the river, as well as quieter areas such as the park. Weaker answers were non-specific about locations or made no reference to the content of the photograph.

Question 2

This question proved to be slightly less accessible than **Question 1**. The theme of **Question 2** was urbanisation and its effects, particularly in LEDCs.

(a) (i) The vast majority of candidates got these calculations right.

(ii) Most interpretations of changes to the number of urban areas for each category were generally accurate. The main discriminator between strong and weak answers was the extent to which the data was used.

(iii) Very few candidates achieved full credit for this question on the rate of growth of urban areas in LEDCs. Most candidates referred to rural to urban migration but did not mention population growth due to natural change. It is a major issue in most urban areas in LEDCs that birth rates greatly exceed death rates.

(iv) Many candidates were able to give the correct reason for the drop in the 5 – 10 million group of urban areas.

(b) (i) The main problem for many candidates was recognising shanty towns as poor quality housing as well as the areas labelled as poor quality. However most were able to refer to poor quality housing as being away from the CBD and on the outskirts of the city due to cost and employment.

(ii) Urbanisation frequently involves cities sprawling into neighbouring non urban land producing environmental, economic and social pressures. Answers to **(ii)** were frequently very general and often not about non-residential land. Environmental issues such as loss of habitat and forest were the most common choices.

(c) There were some excellent assessments of the environmental damage associated with the hillside shanty town (favella) shown in the photograph. These answers referred to up-slope instability, pollution, overcrowding and drainage. Weaker answers tended to refer to either slope instability or pollution and thus achieved half credit.

Section B

Questions 4 and **5** proved to be rather more popular than **Question 3**. Although there were some excellent responses to both part **(a)** and the essay, there were a significant number of poor answers to both parts. Many candidates appeared to find writing essays under examination conditions difficult. Many essays were too short, lacking planning and they frequently suffered from a lack of exemplar material. High quality essays were planned, had a logical structure and incorporated the exemplar material needed; above all they were well written with few errors in spelling, punctuation and grammar. Candidates should be spending about 45 minutes on this section which should give adequate time for essay planning and writing.

Question 3

(a) This question on soil formation elicited quite a wide range of credit. In particular, good answers recognised the importance of time in enabling an interaction between the four components: climate, biology, geology and relief, in contributing to a mature soil. Few difficulties were encountered with climate and biology. However geology and relief proved to be difficult for candidates.

(b) Soil deterioration as a result of agricultural activity is an important element in the syllabus and in a different format, has been set before. The three most popular contributors to soil deterioration were: deforestation and soil erosion, over-cropping or grazing and the use of fertilizers and pesticides. According the ability of the candidate, these were either briefly outlined or covered in a lot of detail. Showing ways in which the fertility of a soil could be sustained proved to be more difficult for candidates. A significant number of answers described how soils could be restored; valid but leaving room for improvement. Good answers covered sustainability by describing and assessing how soils are being, or could be used in future years. Examples of agricultural land familiar to the candidate formed an important feature of the majority of answers.

Question 4

(a) Fig. 4.1 is part of a model that graphs the risks and impacts of global warming. In this case: threats to ecosystems, extreme climatic events and the balance of impacts across the globe. These data proved to be an effective discriminator between strong and weaker candidates. Good answers assessed the level of risk in each of the bars and supported their answer with examples, e.g. ecosystems were seen to at the greatest risk, with regions such as Amazonia and the North American Taiga under threat. Weaker answers made generalised comments, often without reference to Fig. 4.1. Most candidates omitted references to increases in temperature.

(b) This should have proven to be a familiar topic as the role of international agreements/protocols and global warming has been addressed in previous examinations, is a topic of continual media interest and features strongly in most text books. The majority of candidates did quite well with assessments at the national scale being stronger than the international; climatic change was invariably contained within global warming.

At the national level most candidates outlined how measures such as alternative energy, limiting deforestation and generally cutting down on CO_2 emissions would assist in slowing global warming. On the international scale there was quite frequent discussion of the Kyoto Protocol and some confusion with the Montreal Protocol which was primarily concerned with ozone depletion. As expected at the national scale, assessments were a mixture of negative and positive, and at the international scale, assessments were mostly negative with considerable criticism of some specific countries.

Question 5

(a) The two photographs in Fig. 5.1 show two effects of acid rain. Candidates were expected to describe how acid rain contributed to forest degeneration and the chemical weathering of stone. Although there was some considerable variation in credit awarded, most candidates made a good attempt describing how acid rain formed and did moderately well in applying the process to each of the scenes in the photographs. High quality answers were clear about forest dieback and the chemical weathering of stone. Weaker answers gave brief descriptions of acid rain with very limited use of Fig. 5.1.

(b) Responses to this question proved to be disappointing as most candidates did not refer to urban areas and included less on chemical pollution of the atmosphere than was appropriate. The first part of this question was about the sources of chemical pollution. Thus, motor vehicle pollution contributing CO, CO_2 and NO_X, coupled with reference to hot sunny days, increasing ground level ozone and photochemical smog, should have been straightforward. Similarly, emissions from factories and power stations also tend to remain in urban areas. The assessment of methods of reduction was much better answered and here most candidates provided quite critical descriptions of the measures adopted within a named urban area.

It was a common pattern to see good quality answers developing both elements of the question and weaker answers only developing one element.

ENVIRONMENTAL MANAGEMENT

Paper 8291/13

Lithosphere and Atmosphere

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General comments

Once again there has been a substantial increase in the entry. As in previous sessions, candidate performance was varied. In this session, a significant number of candidates found the data response questions in **Section A** slightly more difficult than the discursive questions in **Section B**. The quality of written English was mostly of a high standard with many of the essays a pleasure to read. There is a need to remind candidates to read questions carefully and, particularly in **Section A**, achieve consistency through a set of linked data response questions. Overall this paper proved to be an effective test of both knowledge and the ability to analyse a wide variety of data and topical issues derived from the atmosphere and lithosphere sections of the syllabus. Like previous examinations, candidates found questions based on the Lithosphere and Atmosphere topics somewhat more difficult than those in the Hydrosphere and Biosphere paper.

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assessment of the extent to which people were affected by noise pollution, there was a need to use the data in Fig. 1.1. This proved to be a discriminator between good and moderately good answers as the latter were mostly very general and descriptive without the use of the data.

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Question 2

This question proved to be slightly less accessible than **Question 1**. The theme of **Question 2** was urbanisation and its effects, particularly in LEDCs.

(a) (i) The vast majority of candidates got these calculations right.

(ii) Most interpretations of changes to the number of urban areas for each category were generally accurate. The main discriminator between strong and weak answers was the extent to which the data was used.

(iii) Very few candidates achieved full credit for this question on the rate of growth of urban areas in LEDCs. Most candidates referred to rural to urban migration but did not mention population growth due to natural change. It is a major issue in most urban areas in LEDCs that birth rates greatly exceed death rates.

(iv) Many candidates were able to give the correct reason for the drop in the 5 – 10 million group of urban areas.

(b) (i) The main problem for many candidates was recognising shanty towns as poor quality housing as well as the areas labelled as poor quality. However most were able to refer to poor quality housing as being away from the CBD and on the outskirts of the city due to cost and employment.

(ii) Urbanisation frequently involves cities sprawling into neighbouring non urban land producing environmental, economic and social pressures. Answers to **(ii)** were frequently very general and often not about non-residential land. Environmental issues such as loss of habitat and forest were the most common choices.

(c) There were some excellent assessments of the environmental damage associated with the hillside shanty town (favella) shown in the photograph. These answers referred to up-slope instability, pollution, overcrowding and drainage. Weaker answers tended to refer to either slope instability or pollution and thus achieved half credit.

Section B

Questions 4 and **5** proved to be rather more popular than **Question 3**. Although there were some excellent responses to both part **(a)** and the essay, there were a significant number of poor answers to both parts. Many candidates appeared to find writing essays under examination conditions difficult. Many essays were too short, lacking planning and they frequently suffered from a lack of exemplar material. High quality essays were planned, had a logical structure and incorporated the exemplar material needed; above all they were well written with few errors in spelling, punctuation and grammar. Candidates should be spending about 45 minutes on this section which should give adequate time for essay planning and writing.

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lot of detail. Showing ways in which the fertility of a soil could be sustained proved to be more difficult for candidates. A significant number of answers described how soils could be restored; valid but leaving room for improvement. Good answers covered sustainability by describing and assessing how soils are being, or could be used in future years. Examples of agricultural land familiar to the candidate formed an important feature of the majority of answers.

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(b) This should have proven to be a familiar topic as the role of international agreements/protocols and global warming has been addressed in previous examinations, is a topic of continual media interest and features strongly in most text books. The majority of candidates did quite well with assessments at the national scale being stronger than the international; climatic change was invariably contained within global warming.

At the national level most candidates outlined how measures such as alternative energy, limiting deforestation and generally cutting down on CO_2 emissions would assist in slowing global warming. On the international scale there was quite frequent discussion of the Kyoto Protocol and some confusion with the Montreal Protocol which was primarily concerned with ozone depletion. As expected at the national scale, assessments were a mixture of negative and positive, and at the international scale, assessments were mostly negative with considerable criticism of some specific countries.

Question 5

(a) The two photographs in Fig. 5.1 show two effects of acid rain. Candidates were expected to describe how acid rain contributed to forest degeneration and the chemical weathering of stone. Although there was some considerable variation in credit awarded, most candidates made a good attempt describing how acid rain formed and did moderately well in applying the process to each of the scenes in the photographs. High quality answers were clear about forest dieback and the chemical weathering of stone. Weaker answers gave brief descriptions of acid rain with very limited use of Fig. 5.1.

(b) Responses to this question proved to be disappointing as most candidates did not refer to urban areas and included less on chemical pollution of the atmosphere than was appropriate. The first part of this question was about the sources of chemical pollution. Thus, motor vehicle pollution contributing CO, CO_2 and NO_X, coupled with reference to hot sunny days, increasing ground level ozone and photochemical smog, should have been straightforward. Similarly, emissions from factories and power stations also tend to remain in urban areas. The assessment of methods of reduction was much better answered and here most candidates provided quite critical descriptions of the measures adopted within a named urban area.

It was a common pattern to see good quality answers developing both elements of the question and weaker answers only developing one element.

ENVIRONMENTAL MANAGEMENT

Paper 8291/21

Hydrosphere and Biosphere

Key messages

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- Apportion your time sensibly between questions and between Sections **A** and **B**.
- Quote data in tables and graphs in order to support points.

General comments

In this hydrosphere and biosphere paper the range of credit is wider than previous years with the majority achieving medium credit. Like paper 1, candidates found the data response questions in **Section A** slightly more difficult than those in **Section B**. **Section A** contains data response questions that largely derive from the environmental science that underpins the management of the environment. **Section B** offers candidates the opportunity of using their personal experiences and knowledge in the broad areas of environmental management. This session saw some excellent use of localised exemplar material.

Although there were many examples of excellent written English there is a need for a move towards improving the quality of essays. The time available for **section B** essays should allow for some planning followed by a structured essay of approximately 750 words, i.e. 3 to 4 pages of A4. Essays should focus on each requirement of the question and contain few or no errors. Whilst many essays were well constructed, a significant number were too short and occasionally the quality of spelling, grammar and punctuation were areas for improvement.

Although most candidates attempted to utilise exemplar material in describing environmental issues and remedial measures, the quality of assessment of the success or otherwise of these was often weak. Like all examinations, there is a need for careful preparation for the examination including revision and question practice.

Comments on specific questions

Section A

For most candidates **Questions 1** was better answered than **Question 2**. Although there were a number of very good answers from candidates, credit varied from low to high. It is important that candidates practice sample questions that involve interpreting data presented in the form of graphs, tables, maps and photographs. However, most candidates coped well with the definition of terms and the final discursive elements of each question.

Question 1

This question focussed on energy transfer within ecosystems with reference to photosynthesis, net primary production (NPP) and interactions within a tropical rain forest.

(a) (i) There were no difficulties in identifying the Sun as the source of energy for photosynthesis.

(ii) The majority of candidates were reasonably clear about the process of photosynthesis; the most frequent omission being the green pigment in plants or chlorophyll capturing light energy. Some weaker answers reversed oxygen and carbon dioxide and omitted the production of glucose or carbohydrates. A small number of candidates attempted to state the equation for photosynthesis.

(iii) Most candidates made a good attempt at the interpretation of Fig. 1.1. Full credit was obtainable for a straightforward description of the graph without any explanation. Common errors that took answers away from the credit available were ignoring the limit on light intensity and assuming that the rate of photosynthesis continuously increased with temperature. In this case, the role of CO_2 was not adequately described.

(b) Many candidates achieved low credit for this question. Most gave brief descriptions and showed poor understanding of the savanna biome. Although limited credit was often achieved through references to greater biodiversity in regions of temperate forest, few candidates mentioned the importance of rainfall and savannas were not recognised as tropical grassland; a significant number thought they were deserts.

(c) Few candidates found themselves without something to write about in this part; the coloured photograph was an excellent prompt. Either implicitly or by statement, nearly all recognised the river and rain forest ecosystems and had a good understanding of abiotic and biotic factors. The main difficulty lay in describing the interactions.

Question 2

Answers to this question fell into two distinct marking areas. Parts **(a)** and **(b)** were adequately answered, but part **(c)** was more poorly answered.

(a) (i) The vast majority of candidates calculated both correctly, but a small number added rather than subtracted.

(ii) As many answers contained reasons that had not been developed, most candidates achieved half credit. For Europe and Africa most stated that one was richer than the other and for the second element, Asia had a larger population than Africa. There were few references to the availability of water, public services and the reasons for differences in sanitation.

(b) This question on the contamination of river water was well answered. Fig. 2.2 contained a lot of information and most candidates made clear references to point and non-point sources. Some even described how a point source could eventually become a non-point source, e.g. smoke emissions from factories contributing to acid rain which is then transferred to another location.

(c) (i) This was found to be difficult by candidates. Whilst many mentioned the needs of a growing global population, only a small number developed the agricultural and domestic implications of this. Very few mentioned the increasing gap between extraction and consumption of water and how this could be linked to wastage.

(ii) Some weak responses were given by candidates in this part. Some did not recognise the seeming contradiction and less than 50% of the answers mentioned untapped reserves and improvements to water supply technology.

Section B

There was a reasonable balance in the number of responses to the three questions in **Section B**. Although there were some excellent responses to both part **(a)** and the essay, as with paper 11, there were a significant number of poor answers to both parts. Many candidates appeared to find writing essays under examination conditions difficult. Many essays were too short, lacking planning and they frequently suffered from a lack of exemplar material. High quality essays were planned, had a logical structure and incorporated the exemplar material needed; above all they were well written with few errors in spelling, punctuation and grammar. Candidates should be spending about 45 minutes on this section which should give adequate time for essay planning and writing.

Question 3

This was a question on the contributing factors to river discharge and the nature and causes of floods. A significant number of answers in part **(a)** showed an incomplete analysis of the hydrograph and a significant number of part **(b)** essays considered only one half of the question. It is important to remind candidates to thoroughly read the question and for Centres to make certain the topic is fully taught.

(a) The majority of candidates gave accurate interpretations of the pattern of rainfall and discharge. Errors occurred in describing the timing of each aspect and the lag time was not adequately explained. The most important feature of the rainfall event and the discharge curve is the time it takes for water to enter the river, i.e. the lag time. This involves rain being intercepted by vegetation, infiltration, ground water flow and sometimes surface run-off. As the ground acts as a temporary store, the river is fed with water long after the peak of discharge. Most candidates missed this feature of the hydrograph.

(b) The majority of answers covered only human contributions such as dams and reservoirs, urban development, the mismanagement of rivers and deforestation. These essays only achieved a maximum of half credit (the top of band 3).

River flooding would not take place unless natural processes, either alone, or in conjunction with human activity. are present. Nearly all candidates did not show that rain was the prime cause of river flooding. This naturally leads into rates of infiltration, surface run-off and a rapid flow of water into the river. The river floods because it cannot contain its discharge. This point applies to river systems where human activity is a contributing factor.

Most candidates did select suitable examples of rivers that frequently flood and outlined how human activity made a contribution. The Mississippi and its burst levees formed the most common example. Many mentioned dam construction and the flooding that occurred upstream from a dam after its construction; although reasonably valid, such flooding is an expectation rather than an unplanned disaster.

Question 4

(a) Many answers used the key to describe the degrees of pressure on the region. About a third of the answers described the types of pressures that might result and a very small number named the common location for all three activities.

(b) Candidates were far more confident about this essay on the policies being used to conserve ecologically important areas. Although answers varied in quality, good use was made of the Everglades, Alaska, and the Rocky Mountains. There were some excellent answers that used the Australian Great Barrier Reef.

It was not necessary to provide a lengthy ecological justification for the conservation policies but to evaluate the success of those policies. In this respect, most candidates developed assessments of National Parks. The quality of the answers related to the coverage of measures operating within the chosen example. Good answers referred to controls of exploitation, the management of visitors and the work done by people employed within the park. Weaker answers gave a brief description of how the National Parks operate.

Question 5

The question on urban water was slightly more popular than **Questions 3** and **4** and obtained a greater range of credit. Answers to part **(a)** were of a better quality than part **(b)**.

(a) Most candidates used Fig. 5.1 quite well with most outlining how the sustainable elements were an answer to the issues associated with an unsustainable water supply. The quality of the answers varied according to the extent to which the sustainable side was developed; weak answers tended to be either too brief or spent most time on the how rivers become unsustainable. The only element that was missing from many answers was use of the concept of ‘sustainability’.

(b) Strong candidates were, very appropriately, keen to draw upon local knowledge and utilised local schemes in describing a variety of measures. However, many of these answers failed to assess the success or limitation of the measures. Weaker answers were derived from either being too brief or were more concerned with rural areas.

ENVIRONMENTAL MANAGEMENT

Paper 8291/22

Hydrosphere and Biosphere

Key Messages

- Adequate preparation for the examination is essential. This includes learning the facts, possessing the necessary skills of analysis and interpretation, and practising on questions from past papers.
- Read questions carefully and, particularly in section **A**, achieve consistency through a set of linked data response questions.
- Ensure you understand the various question instructions, and answer only what is asked. Irrelevant answers, even though correct in themselves, will not gain credit and will waste your valuable time.
- Use the published mark schemes to identify the type of answer, both in content and length, required by different questions. Use the allocated number of marks in the question paper to assist you in constructing your answer.
- Apportion your time sensibly between questions and between Sections **A** and **B**.
- Quote data in tables and graphs in order to support points.

General Comments

There was no significant difference in performance between ***Sections A*** and ***B*** of this paper. Candidates effectively demonstrated their knowledge and understanding of key processes and their ability to manage data appropriately on both the Hydrosphere and Biosphere in ***Section A*** together with effective use of the exemplar material in ***Section B***.

In the main, candidates read and understood the questions. There were no rubric errors. The importance of closely following instructions in order to access all the available credit was particularly evident in ***Section B***. When essays are well planned, all aspects of the question are considered and all of the question requirements are fulfilled. Essays were particularly enhanced by candidates drawing upon local knowledge gained through local studies, and also by referring to a broad range of examples.

Comments on Specific Questions

Section A

Question 1

(a) Responses to this question on water stores and the pollution of groundwater were quite varied; the part of the question about the features of natural aquifers, both confined and unconfined, posed the greatest challenge.

(i) Candidates used information from Fig. 1.1 appropriately to identify stores and elicit an explanation. Occasionally Fig. 1.1 was read incorrectly and the stores with the longer residence times were identified in error, or an important store, e.g. the biospheric water, was omitted from the choices. Some answers were characterised by either simply stating that water is lost quickly from these stores, or giving a generalised explanation pertaining to a small quantity of water or to the ease of extraction, collectively to all of stores listed. Good answers linked each store to a specific process emphasising the temporary nature of the hydrological cycle, e.g. transpiration within the biosphere. Sometimes candidates gave a reverse argument and explained why other stores had long residence times; this was an explanation required in part **(ii)** of the question.

(ii) This was not as well answered as part **(i)**. Some candidates misunderstood the question and tried to explain how a residence time could be estimated. The question required the use of appropriate information from Fig. 1.1. In weaker answers one reason was applied to all the stores identified, or a simple reason was given such as stating 'groundwater is underground' without giving further exemplification. Often the large volume or the inaccessibility of the water store was considered and, in addition, in good answers cold climates or depth in relation to groundwater not exposing the water store to losses through human consumption or evaporation were mentioned.

(iii) Most candidates gave adequate answers which conveyed some idea of permanence and reliability. A few candidates indicated that residence times were a more meaningful indicator for future plans for water supply than the volume of water. The idea of sustainability, avoiding overexploiting, or depletion of water resources was particularly evident in good answers. Some answers only focused on types of human activity, rather than the sources of the water.

(b) (i) This was poorly answered as few had any idea about geological conditions, i.e. the location of the permeable and impermeable strata and of the distinction between permeable / less permeable and impermeable, or just referred to confining and unconfining layers without exemplification. Answers often involved the hydrological processes transpiration, evaporation and precipitation from Fig. 1.2. The position of the water table was incorrectly described in some answers.

(ii) Good answers were achieved through one of two routes: the natural losses and gains within the water cycle or losses and gains involving human activity, extraction of water from an aquifer followed by recharging. The best answers combined both of these. Overall the balance was well understood and many candidates were awarded most of the available credit. Only very good answers referred to the balance with regard to confined and unconfined aquifers separately for full credit.

(iii) There were many correct answers, where specific examples of contamination from different sources were chosen, while some answers even referred to point and non-point sources of pollution. The only thing that was sometimes missing was the processes of infiltration and percolation of the contamination down to the water table and aquifer.

Question 2

This question obtained moderately good answers for all parts except **(a)(iv)**. Responses to part **(b)** were varied.

(a) (i) This part was generally well answered with most receiving credit for defining a food chain as a sequence of organisms showing feeding relationships, although there were few references to a flow of energy. Candidates could correctly identify trophic levels with reference to Fig. 2.1, but found the definition more difficult to articulate; this was sometimes a repetition of a food chain but most mentioned a distinct level or stage in a food chain and cited an example from Fig. 2.1.

(ii) The vast majority of candidates achieved full credit for a correct food chain. In a few answers the order of the food chain was reversed, with the food chain in the wrong direction above the producer level, or the hawk and mouse were incorrectly identified as primary consumer and secondary consumer.

(iii) This part was also well answered with many referring to losses to the grazing food chain as heat from respiration or via excretion to the decomposer food chain, and occasionally as a result of incomplete consumption. Transpiration was sometimes given incorrectly in place of respiration. Weaker answers referred to a higher number of producers and lower numbers of consumers, or stated that only 10% of energy is passed to the next trophic level; neither of these answers explained the decrease.

(iv) This part was less well answered to varying degrees. The pyramid of numbers illustrated the relative numbers of the named organisms at each trophic level of a food chain which gave a lot of clues to the energy flow and losses through the food chain. Very few candidates actually used the data in Fig. 2.1 to emphasise the decrease in energy at each level, and instead just described the reduction in numbers in the food chain. In better answers, some candidates calculated the energy transfer using the data in Fig. 2.1 and quoted the energy available to pass on to the next trophic level as a percentage, while others used the data provided to illustrate the transfer of energy in respiration and excretion and the loss to the grazing food chain. These good answers explained the reduction in terms of the available energy at a given trophic level, and the energy requirements of the organisms at the trophic level, therefore determining the number of organisms that can be sustained at that level. In some answers the reduced numbers at each trophic level were explained independently in terms of population dynamics, suggesting other factors such as disease, other grazers or other predators – this would be an appropriate addition to the energetic discussed above.

(b) (i) A variety of approaches were used in answering this part of the question and most importantly the use of supporting evidence from Fig. 2.3. The majority of candidates provided a description of each of the two tables. Weak answers were typified by providing a simple description of each, continent by continent. Others took a more refined approach, emphasising the large number of protected sites related to few threatened species, e.g. Europe or vice-verse for Asia. Very good answers referred to an inverse correlation and some high quality answers also highlighted anomalies where some data did not fit the pattern described. Others were, in addition, appropriately critical in their appraisal of the data, with comments on the validity of the data, due to the lack of an indication of the relative size of each of the protected areas.

(ii) This part also generated varied responses with the main difficulty that candidates found being the identification of distinct factors. Some simply stated biodiversity of ecology rather than giving specific factors that would threaten the species such as hunting, urban development, climate change, etc. The factors were infrequently linked to Fig. 2.2, and therefore few answers scored full credit. A good answer would include both specific factors as listed above and clear cross-references to Fig. 2.2.

Section B

Question 4 was less popular than **Questions 3** and **5**; however performance of similar candidates was similar in each.

Question 3

(a) Few answers scored highly. Reasons for oil exploration and production were well developed, but weak answers only elaborated on this aspect of the question, with no comparison to the other contributors, e.g. rivers discharge vast quantities of domestic, agricultural, and industrial waste into the seas. The highest scoring responses were those that achieved some balance, recognising the contribution of other sources and giving a comparative explanation.

(b) This was rather better answered than **(a)**. However, many answers were more concerned with *causes* relating to the sources listed in Fig. 3.1 than the *effects*. Examples of marine pollution were occasionally limited to examples of oil tanker spills and a description of birds covered in oil. There were, however, some excellent descriptions of the effects of pollution on marine ecosystems, coastal waters and coral reefs. Good answers made references to specific effects on aquatic marine life and on the marine environment, including the disruption to food chains and food webs, toxic contamination leading to bioaccumulation in the food chain. These were well elaborated in such answers. The use of the ecosystems suggested for study in the syllabus, the Galapagos Islands and the Great Barrier Reef were used effectively as exemplar material.

The answers to the second part were usually better as most outlined the international spread of marine pollution, the lack of enforced legislation and scale (size of oceans). Occasionally this second part was omitted from essays.

Question 4

(a) This question was also rather poorly answered although the data is widely available and the underlying ideas should have been familiar to candidates. Some referred to Fig. 4.1 and gave a year by year description of the peaks and troughs in the population numbers with no overall pattern being identified. There was sometimes no recognition of the food chain, the rabbit as a herbivore, being the prey, and the lynx as a predator, or of their relative trophic levels and the pattern of the predator / prey relationship. Very often the changes in rabbit numbers were described independently to those of the lynx. In other answers, other causal factors were assigned. High quality answers recognised the two animals as occupying separate trophic levels, the feeding relationship between the rabbit as prey and the lynx as predator, and accounted for the population changes in terms of food availability and competition for food. Some also mentioned the gradual decline in numbers from left to right on the graph, and suggested other factors which might have contributed to the fluctuations in the pattern over time.

(b) There was quite a wide range of credit awarded for this essay which was aimed at comparing two different approaches to the conservation, preservation and restoration of ecosystems, maintaining biological diversity through wildlife management. Many only discussed safari parks, or considered the zoo and safari park together so that any merits were considered to apply equally to both. When the zoo and safari park were considered separately there was sometimes a lack of balance. Good answers achieved a balance of zoos and safari parks and the merits of breeding, research, ecotourism and the role of education. There was also emphasis on the more natural habitat of safari parks, and acknowledgment of the role of zoos, particularly in a breeding program aimed at the release of endangered species back to the wild. Very few answers directly compared merits of both, and relative merits were restricted to only a few answers at the highest level. There was some good use of local exemplar material.

Question 5

This question on the impact of climate change, the usage of natural water supplies and the sustainability of water supply was the most popular ***section B*** question and in general was somewhat better done than the others.

(a) Weak answers commented on each store independently and made no links. Some good responses made links between the stores and recognised how changes in one store would affect another. These answers developed a sequence of events relating the amount of water in stores, e.g. warming – ice caps melt – increases volumes in oceans – increased flooding, or mountain glaciers melt – increased volume in rivers – increases in sea level. Most responses outlined decreases. In good answers these points were accompanied by references to increased surface evapotranspiration, increases in atmospheric water vapour and localised increases in rainfall. Very good answers expressed uncertainty in some of the changes, and emphasised a change in state of water from solid ice to liquid water, or water to water vapour.

(b) There was a wide variety of answers seen. There were many over-generalised answers which often lacked focus on climate change. These gave little more than a brief idea that water supply would somehow be affected but with limited comment on how this might specifically affect agriculture, industry and domestic supply. Where individual effects were considered, candidates often found it easier to concentrate on the consequences of climate change on plant growth; the effect of drought and sometimes flooding on agriculture. Good answers indicated linked changes, such as increased evaporation, leading to reduced water stores, less water for irrigation in agriculture; less precipitation leading to reduced river flow reducing the water available for cooling in industry, or HEP generation or rise in sea level or contamination of groundwater through salinisation affecting the quality of water extracted.

The latter part was better answered with references to dams / reservoirs, water conservation and the sustainable use of water reserves. Many candidates were well versed in the development of some schemes from their chosen country and used these examples effectively in their evaluation. There were some weaknesses in the assessment by candidates, particularly when a country was not named, where more than one country was referred to, or where many ways were listed which often lacked detail. These situations often resulted in less effective evaluation of the strategies.

ENVIRONMENTAL MANAGEMENT

Paper 8291/23

Hydrosphere and Biosphere

Key Messages

- Adequate preparation for the examination is essential. This includes learning the facts, possessing the necessary skills of analysis and interpretation, and practising on questions from past papers.
- Read questions carefully and, particularly in section **A**, achieve consistency through a set of linked data response questions.
- Ensure you understand the various question instructions, and answer only what is asked. Irrelevant answers, even though correct in themselves, will not gain credit and will waste your valuable time.
- Use the published mark schemes to identify the type of answer, both in content and length, required by different questions. Use the allocated number of marks in the question paper to assist you in constructing your answer.
- Apportion your time sensibly between questions and between Sections **A** and **B**.
- Quote data in tables and graphs in order to support points.

General Comments

There was no significant difference in performance between ***Sections A*** and ***B*** of this paper. Candidates effectively demonstrated their knowledge and understanding of key processes and their ability to manage data appropriately on both the Hydrosphere and Biosphere in ***Section A*** together with effective use of the exemplar material in ***Section B***.

In the main, candidates read and understood the questions. There were no rubric errors. The importance of closely following instructions in order to access all the available credit was particularly evident in ***Section B***. When essays are well planned, all aspects of the question are considered and all of the question requirements are fulfilled. Essays were particularly enhanced by candidates drawing upon local knowledge gained through local studies, and also by referring to a broad range of examples.

Comments on Specific Questions

Section A

Question 1

(a) Responses to this question on water stores and the pollution of groundwater were quite varied; the part of the question about the features of natural aquifers, both confined and unconfined, posed the greatest challenge.

(i) Candidates used information from Fig. 1.1 appropriately to identify stores and elicit an explanation. Occasionally Fig. 1.1 was read incorrectly and the stores with the longer residence times were identified in error, or an important store, e.g. the biospheric water, was omitted from the choices. Some answers were characterised by either simply stating that water is lost quickly from these stores, or giving a generalised explanation pertaining to a small quantity of water or to the ease of extraction, collectively to all of stores listed. Good answers linked each store to a specific process emphasising the temporary nature of the hydrological cycle, e.g. transpiration within the biosphere. Sometimes candidates gave a reverse argument and explained why other stores had long residence times; this was an explanation required in part **(ii)** of the question.

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and, in addition, in good answers cold climates or depth in relation to groundwater not exposing the water store to losses through human consumption or evaporation were mentioned.

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(b) (i) This was poorly answered as few had any idea about geological conditions, i.e. the location of the permeable and impermeable strata and of the distinction between permeable / less permeable and impermeable, or just referred to confining and unconfining layers without exemplification. Answers often involved the hydrological processes transpiration, evaporation and precipitation from Fig. 1.2. The position of the water table was incorrectly described in some answers.

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Question 2

This question obtained moderately good answers for all parts except **(a)(iv)**. Responses to part **(b)** were varied.

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Section B

Question 4 was less popular than **Questions 3** and **5**; however performance of similar candidates was similar in each.

Question 3

(a) Few answers scored highly. Reasons for oil exploration and production were well developed, but weak answers only elaborated on this aspect of the question, with no comparison to the other contributors, e.g. rivers discharge vast quantities of domestic, agricultural, and industrial waste into the seas. The highest scoring responses were those that achieved some balance, recognising the contribution of other sources and giving a comparative explanation.

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(a) Weak answers commented on each store independently and made no links. Some good responses made links between the stores and recognised how changes in one store would affect another. These answers developed a sequence of events relating the amount of water in stores, e.g. warming – ice caps melt – increases volumes in oceans – increased flooding, or mountain glaciers melt – increased volume in rivers – increases in sea level. Most responses outlined decreases. In good answers these points were accompanied by references to increased surface evapotranspiration, increases in atmospheric water vapour and localised increases in rainfall. Very good answers expressed uncertainty in some of the changes, and emphasised a change in state of water from solid ice to liquid water, or water to water vapour.

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The latter part was better answered with references to dams / reservoirs, water conservation and the sustainable use of water reserves. Many candidates were well versed in the development of some schemes from their chosen country and used these examples effectively in their evaluation. There were some weaknesses in the assessment by candidates, particularly when a country was not named, where more than one country was referred to, or where many ways were listed which often lacked detail. These situations often resulted in less effective evaluation of the strategies.

ENVIRONMENTAL MANAGEMENT

Paper 8291/03

School Based Assessment

General comments

This session has seen a continuation of the increase in entries. Many Centres continue to enter small numbers of candidates. The trend is towards large entries from individual Centres. This has a number of effects:

- where the Centre entry is small, candidates have little difficulty in finding original topics
- with a larger entry there are often several candidates with the same project topic and title; although this can lead to copying, it also enables candidates to undertake group field work
- staff at some newer Centres were either too lenient, or occasionally severe in the assessment of their candidates' work
- larger entries also raise issues such as: an increase in candidates' work to monitor, meeting deadlines and achieving an accurate rank order of candidates' work.

This year's reports were generally of a high standard. However, as the majority of reports did not contain a clear evaluation or a statistical tool, very few candidates achieved full credit. It is still the case that the best reports derive from the collection and collation of primary data obtained from either field investigations or laboratory work. Increasingly, a significant number of candidates rely on secondary data obtained from the Internet. This tends to result in poorer reports.

Care must be taken to avoid plagiarism and in particular, copying and pasting. Centres should alert to this possibility. CIE will use plagiarism checkers to identify such malpractice, so it is very important that Centres check this before the reports are sent in. So, Centres should be aware that it is the responsibility of CIE Moderators to be vigilant about candidate's use or misuse of the Internet.

It is important that candidates are made fully aware of the requirements of this School Based Assessment. Written reports should be of approximately 2000 words in length. Work much in excess of this will not be credited. The report should ideally be structured into the four stages of 1. scientific method, i.e. introduction, 2. methods (justified), 3. results and analysis, 4. conclusion and evaluation. The better reports use these stages as section or chapter headings. This model of scientific method can be used to provide a check on how well the project is progressing. Candidates should be asking themselves:

- will my hypothesis or question actually yield viable, valid, useable results?
- are my methods realistic, practical and relevant; do they feature primary data from laboratory work or field investigations; do they include data recording, collation and presentational techniques?
- are the results and analyses fully representative of the methods referred to the previous section?
- does my conclusion sum up and relate my results to the original hypothesis or question?
- have I evaluated my work in terms of both its successful features and its limitations?
- what can be done to improve my work?

Finally a word about Centre based assessment. Whilst the majority of Centres assess their candidates very accurately, there is a need for some clarification. A small number of Centres are awarding credit for criteria not present in the research report. This issue particularly applies to the use of statistical tools to analyse data and all, or parts of, Skill C3; Conclusions and Evaluation. It is also quite common to see Centres awarding full credit for a criterion, regardless of its quality; for full credit there should some substance rather than a simple statement or diagram.

Comments on assessment criteria

Skill C1

The majority of candidates continue to perform reasonably well in this skill area.

Either as the project title or as part of an introduction, hypotheses or questions were stated by most candidates. These were generally accompanied by a clear explanation of the underpinning principles. This element should be only about 250/300 words and it was positive to see a reduction in the length of what should be a preface.

This introduction leads into the methods section of the report. Most good quality research requires the formulation of a plan detailing research sites, equipment, expected data and how it will be collated and presented. Although most candidates included a methodology, this was frequently a brief list without any explanation or justification. Additionally, only a small number of candidates assessed whether or not their developed plan would be effective in testing their hypothesis or answering their question.

The better projects achieved these goals, whilst weaker reports did not specify the details of their topic and were unclear about how it should be investigated or its likely effectiveness.

Skill C2

There were a significant number of high quality research reports that did very well in this section. Such reports made excellent use of relevant collected data which was presented in a variety of ways including graphs, tables, diagrams and photographs; invariably integrated into an analysis through the use of figure references.

For the remaining candidates there was a wide variation across the five criteria in this section, with the main areas for improvement being within data collection / presentation and the use of a statistical tool. A significant number of candidates offered limited evidence of data collection. Some reports showed a mismatch between the stated methodology and the presentation of related results. In these instances the methods stated in **C1** did not yield the expected related graphs, tables and photographs. On other occasions, collected data was hidden within descriptive text. Occasionally, diagrammatic or pictorial materials such as photographs were present, but they were not adequately referred to in the analysis or description.

The use of a statistical tool is also an area for improvement. There is a difference between statistical methods that are used to *describe* data and statistical tools that are used to *analyse* data. The former might include bar charts, line graphs or descriptive statistics such as standard deviation. The latter, analytical statistical techniques, would include numerical techniques such as correlation, chi-squared, t-test or regression. Some Centres awarded this mark when there was no evidence of statistics.

The majority of candidates achieved credit for the general organisation of their work and the quality of written communication.

Skill C3

This final skill area is an important feature of almost any scientific investigation. The better reports contained a detailed summative conclusion that utilised results to assess the original hypothesis. However, a significant number of candidates did not refer to their data and therefore lost credit. Likewise, although most reports contained references to environmental and management principles, they were not used to explain trends and patterns derived from results contained in the body of the report.

A minority of candidates attempted an evaluative assessment of their work. This included a brief survey of those things that went well and not so well, i.e. success and limitations.

Concluding comments

It is positive that Centres and their candidates are engaging enthusiastically with this element of the Environmental Management examination. The rationale behind its inclusion in the syllabus is to give candidates the opportunity to research a topic of their own choice that falls within the broad content area of the syllabus. As in previous sessions, the better topics and final reports were derived from locally based research; ideally these should utilise primary data.

Candidates who rely on secondary data, particularly the Internet, do need to take care. Reports based on such data can have poor structure. Prior to using the Internet or texts, candidates should carefully research the background to their topic; decide upon a central theme and the nature of the data they will require. It should be noted that whilst Internet data can be utilised to produce graphs and tables, these should be of the candidate's own construction. Plagiarism and copying / pasting are not permitted and could invalidate the research project; in these cases a grade for the examination may not be awarded.

All Centres should make themselves fully aware of the assessment and recording procedures. Trying to rectify Centre errors in assessment or moderation of coursework is be time-consuming and potentially may contribute to less secure moderation of a research report. The main issues that arose this year were:

- some Centres did not return the MS1 form
- only whole numbers should be recorded on the various assessment forms; some Centres put half marks on the candidate record cards, then transferred these to the MS1 form
- credit was sometimes given for elements not present in the research report, particularly for criteria **C2e** and **C3c**
- based on their total entry, some Centres sent insufficient projects for moderation (**all** reports for an entry of less than 10, a sample of **10** for an entry of between 10 and 49, **15** for an entry in excess of 50, etc.)
- the best and/or worst reports were not always included in the sample
- some Centres submitted their moderation sample very late, occasionally beyond the deadline.

Although these comments refer to only a small number of Centres, it is important that the moderation procedures are efficiently undertaken for the benefit of Centres and their candidates.