ENVIRONMENTAL MANAGEMENT

Paper 8291/11
Paper 11

Key messages

- Candidates should take into consideration the equal balance between ***Section A*** and ***Section B*** of the paper and plan their time and answers accordingly.
- In ***Section A***, candidates should note the number of marks available for each part question and write their answers accordingly. This will give them an indication of the amount of content and detail expected.
- It is important that instructions are followed carefully. Candidates should be clear about the differences in meaning of command words such as state, suggest, explain, describe and evaluate. Candidates should remember that if the question asks for a specified number of factors, no further credit is available if they offer more, for example in **Question 1(b)(i)**.

General comments

There was a reasonably good response to all questions on this paper, though in some cases performance was uneven across the two sections of the paper. Some candidates found **Question 1** (soils and mass movements) less demanding than **Question 2** (climate and air circulation). Topics which proved most challenging were the reasons for low pressure at the equator, formation of clouds and rainfall at the tropics.

Many answers showed a good understanding of terms and attention to detail, with effective use of exemplar material.

Stronger answers included effective use of appropriate examples to illustrate key points along with supporting details using appropriate terminology.

Comments on specific questions

Section A

Question 1

(a) (i) Candidates found it difficult to define mass movement. Few referred to the influence of gravity or that it was downwards in direction. Weaker responses discussed tectonic plate activity.

(ii) Candidates were able to correctly complete the diagram with the types of mass movement. The most common confusion was between mud flow and soil creep.

(iii) The difference between a flow and a slide was well-understood; identifying the similarity as speed was less frequently seen.

(iv) The processes leading to heaves were less well-understood. More successful answers described freeze and thaw and hinted at the effects of water. Weaker responses discussed plate tectonic movements as in **Question 1(a)(i)**.

(b) (i) The most successful choices here were vegetation and climate, although the latter was rarely chosen. Responses tended to be weaker on rock type and river activity. The least chosen option was soil moisture.

(ii) Candidates showed a good understanding of how human activity might trigger mass movement on slopes with a wide range of valid reasons. Some weaker answers listed rather than explained the reasons.

Question 2

(a) (i) Generally, candidates were able to describe the distribution of the equatorial climate. Some weaker responses chose to describe the climate rather than the distribution.

(ii) Candidates were generally able to match the climate data to the correct city.

(iii) Candidates performed well on this question and were able to select the appropriate data from the charts and compare them. More successful responses used the data to support the statements.

(b) (i) Candidates were able to describe the air circulation using the diagram. Some confusion arose from candidates mistaking the 0° latitude of the equator with a temperature reading which led to errors in this and subsequent questions.

(ii) Some candidates had difficulty suggesting why there is low pressure at the equator. Some correctly related this to the temperature but were unable to develop their ideas further. There were references made to the cloud and rain on the diagram, which were not relevant for this question.

(iii) Successful answers were able to relate cloud formation to the rising air cooling and condensing. There was some evidence that candidates found it challenging to apply their knowledge to the setting of this question at the equator.

(iv) This concept was not well understood with few candidates able to explain why there is low rainfall at the tropics. Most creditworthy responses were able to suggest that the air descended but were unable to develop this statement further.

(v) Candidates were generally able to explain the effects of drought on people and the natural environment. Weaker responses were less likely to address the environment part of the question.

Section B

Question 3

(a) This was the least popular of the three questions available and was often less well answered when chosen. Candidates found the description of the diagram showing ozone distribution straightforward but were generally unable to explain the different processes by which ozone is produced. Successful responses were able to provide some details of the chain reaction in the atmosphere.

(b) Answers tended to be very generalised and candidates showed little understanding of the strategies used to manage the concentration of ozone. Many responses were vague with sweeping statements about vehicle exhausts and refrigerators but offered few strategies to control these. Where credit was awarded, it was for suggestions such as catalytic converters and factory emission control. No candidates suggested electric vehicles as a solution in the future.

Question 4

(a) Candidates showed a good understanding of the management scenarios for tectonic hazards. Weaker answers tended to copy the details of the diagram rather than develop the depth and provide supporting examples. Successful candidates took the diagram as a stimulus to provide detailed descriptions of the different phases.

(b) Candidates showing good understanding of the differences resulting from varying levels of economic development. Stronger responses used a good range of examples and provided comparisons throughout. Weaker answers gave sweeping generalisations and often did not use named examples.

Question 5

(a) Candidates showed good understanding of the causes of acid precipitation and were able to use the information in the figure to develop their responses. Stronger answers included details of the chemical reactions which produced the acid precipitation and details of potential causes. Less successful answers provided brief descriptions of the stimulus figure and little development beyond that information.

(b) Weaker responses did not provide details of the different renewable energy sources or explain their contribution to solving pollution issues. Some answers were merely lists. Stronger candidates provided detailed examples of each method and a balanced description and concluded how the pollution would be reduced.

ENVIRONMENTAL MANAGEMENT

Paper 8291/12
Paper 12

Key messages

- Candidates should take into consideration the equal balance between ***Section A*** and ***Section B*** of the paper and plan their time and answers accordingly.
- In ***Section A***, candidates should note the number of marks available for each part question and write their answers accordingly. This will give them an indication of the amount of content and detail expected.
- It is important that instructions are followed carefully. Candidates should be clear about the differences in meaning of command words such as state, suggest, explain, describe and evaluate. When asked to use a figure to describe differences, candidates should limit their answers to what can be seen in the figure, for example in **Question 1(a)(ii)**.

General comments

There was a reasonably good response to all questions on this paper although in some cases performance was uneven across the two sections of the paper. Some candidates found **Question 1** (volcanoes) less demanding than **Question 2** (energy budget and climate). Topics which were most challenging were the explanation of the different climates due to latitude and why oceans warm more slowly than land.

Many answers showed a good understanding of terms and attention to detail, with effective use of exemplar material.

Stronger answers included effective use of appropriate examples to illustrate key points along with supporting details using appropriate terminology.

Comments on specific questions

Section A

Question 1

(a) (i) A good understanding of the type of plate boundary was shown.

(ii) Good descriptions were given of the differences between the two types of volcano.

(iii) This was well answered with good understanding shown of the hazards associated with volcano A. Most successful answers used technical language such as nuees ardentes, lahars and pyroclastic flow correctly. Weaker responses tended to be repetitive in that they gave the same result for each example.

(b) (i) Good descriptions of the distribution of the volcanoes were given.

(ii) Candidates showed a good understanding of the processes leading to volcanic activity with detailed descriptions provided.

(iii) Candidates showed a good understanding and provided named examples of monitoring techniques as well as detailed descriptions. Less successful responses provided generalised descriptions and no named examples.

Question 2

(a) (i) Many candidates found it difficult to explain the balanced budget and there was evidence of confusion between economics and energy budgets. Successful responses related incoming and outgoing amounts being the same and referred to the numbers.

(ii) The calculation proved challenging for many, with candidates selecting incorrect numbers from the diagram to perform the subtraction.

(iii) The role of clouds in absorption and reflection was well-understood with candidates providing good answers.

(iv) Some reasonable understanding was shown of human activity influencing the Earth's energy budget, especially the emissions of carbon dioxide. Weaker responses used ozone depletion as an example, and tended to describe a pollution issue without explaining how it affected the budget.

(b) (i) There was generally good use of the data from the diagram for the description here, although the explanations were less good. The angle of incidence and intensity of insolation were correctly described in a few responses of a higher standard.

(ii) Many candidates left this question blank and few successfully described specific heat capacity or the effects of depth penetration and currents.

Section B

Question 3

(a) This was a popular question and was generally well-answered with candidates able to provide a good description of the developments from Pangaea to the present day. High scoring responses provided detailed evidence that was developed beyond that of the jigsaw theory.

(b) This was quite well-answered with a good range of examples covering monitoring, planning and response to tectonic hazards. Stronger responses also included valid examples and made good comparisons, often referring to economic development, though this was not specifically required.

Question 4

(a) This was generally well-answered with more successful responses comparing the graphs and quoting figures and showing some manipulation of the data. Weaker answers focused on the graphs as separate entities and merely described the trends.

(b) Candidates found this part more challenging and responses gave too few examples such as low-lying countries or those relying on colder climates. Answers were descriptive of climate change and included some consequences, but remained generalised.

Question 5

(a) **Question 5** was the least well-answered of the choices, with most candidates for this part simply describing information given in the diagram without extending the explanation or providing examples which would have explained the link between population expansion and soil deterioration.

(b) Some understanding of the management of soil quality was shown, but few candidates were able to relate this to the level of economic development or provide named examples.

ENVIRONMENTAL MANAGEMENT

Paper 8291/13
Paper 11

Key messages

- Candidates should take into consideration the equal balance between ***Section A*** and ***Section B*** of the paper and plan their time and answers accordingly.
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General comments

There was a reasonably good response to all questions on this paper, though in some cases performance was uneven across the two sections of the paper. Some candidates found **Question 1** (soils and mass movements) less demanding than **Question 2** (climate and air circulation). Topics which proved most challenging were the reasons for low pressure at the equator, formation of clouds and rainfall at the tropics.

Many answers showed a good understanding of terms and attention to detail, with effective use of exemplar material.

Stronger answers included effective use of appropriate examples to illustrate key points along with supporting details using appropriate terminology.

Comments on specific questions

Section A

Question 1

(a) (i) Candidates found it difficult to define mass movement. Few referred to the influence of gravity or that it was downwards in direction. Weaker responses discussed tectonic plate activity.

(ii) Candidates were able to correctly complete the diagram with the types of mass movement. The most common confusion was between mud flow and soil creep.

(iii) The difference between a flow and a slide was well-understood; identifying the similarity as speed was less frequently seen.

(iv) The processes leading to heaves were less well-understood. More successful answers described freeze and thaw and hinted at the effects of water. Weaker responses discussed plate tectonic movements as in **Question 1(a)(i)**.

(b) (i) The most successful choices here were vegetation and climate, although the latter was rarely chosen. Responses tended to be weaker on rock type and river activity. The least chosen option was soil moisture.

(ii) Candidates showed a good understanding of how human activity might trigger mass movement on slopes with a wide range of valid reasons. Some weaker answers listed rather than explained the reasons.

Question 2

(a) (i) Generally, candidates were able to describe the distribution of the equatorial climate. Some weaker responses chose to describe the climate rather than the distribution.

(ii) Candidates were generally able to match the climate data to the correct city.

(iii) Candidates performed well on this question and were able to select the appropriate data from the charts and compare them. More successful responses used the data to support the statements.

(b) (i) Candidates were able to describe the air circulation using the diagram. Some confusion arose from candidates mistaking the 0° latitude of the equator with a temperature reading which led to errors in this and subsequent questions.

(ii) Some candidates had difficulty suggesting why there is low pressure at the equator. Some correctly related this to the temperature but were unable to develop their ideas further. There were references made to the cloud and rain on the diagram, which were not relevant for this question.

(iii) Successful answers were able to relate cloud formation to the rising air cooling and condensing. There was some evidence that candidates found it challenging to apply their knowledge to the setting of this question at the equator.

(iv) This concept was not well understood with few candidates able to explain why there is low rainfall at the tropics. Most creditworthy responses were able to suggest that the air descended but were unable to develop this statement further.

(v) Candidates were generally able to explain the effects of drought on people and the natural environment. Weaker responses were less likely to address the environment part of the question.

Section B

Question 3

(a) This was the least popular of the three questions available and was often less well answered when chosen. Candidates found the description of the diagram showing ozone distribution straightforward but were generally unable to explain the different processes by which ozone is produced. Successful responses were able to provide some details of the chain reaction in the atmosphere.

(b) Answers tended to be very generalised and candidates showed little understanding of the strategies used to manage the concentration of ozone. Many responses were vague with sweeping statements about vehicle exhausts and refrigerators but offered few strategies to control these. Where credit was awarded, it was for suggestions such as catalytic converters and factory emission control. No candidates suggested electric vehicles as a solution in the future.

Question 4

(a) Candidates showed a good understanding of the management scenarios for tectonic hazards. Weaker answers tended to copy the details of the diagram rather than develop the depth and provide supporting examples. Successful candidates took the diagram as a stimulus to provide detailed descriptions of the different phases.

(b) Candidates showing good understanding of the differences resulting from varying levels of economic development. Stronger responses used a good range of examples and provided comparisons throughout. Weaker answers gave sweeping generalisations and often did not use named examples.

Question 5

(a) Candidates showed good understanding of the causes of acid precipitation and were able to use the information in the figure to develop their responses. Stronger answers included details of the chemical reactions which produced the acid precipitation and details of potential causes. Less successful answers provided brief descriptions of the stimulus figure and little development beyond that information.

(b) Weaker responses did not provide details of the different renewable energy sources or explain their contribution to solving pollution issues. Some answers were merely lists. Stronger candidates provided detailed examples of each method and a balanced description and concluded how the pollution would be reduced.

ENVIRONMENTAL MANAGEMENT

Paper 8291/21
Paper 21

Key messages

- In both ***Section A*** and ***Section B***, when considering source material, candidates should select and use relevant information and data to support answers.
- Data extracted should be manipulated, and not simply quoted from tables, graphs and bar charts, to carefully analyse information.
- Working should be shown in calculations.
- Candidates need to understand and act upon the command word in each question, for example, to describe: the main points need to be stated and should include reference to associated observations.
- Subject specific vocabulary should be used in answers and terms defined as appropriate.
- In ***Section B***, candidates should use specific examples to allow for pertinent evaluation of the strategies used in environmental management.

General comments

In ***Section A***, candidates performed equally well in **Questions 1** and **2**. There was good use of information from the source material in ***Section A.*** Overall, candidates performed better in ***Section A*** than ***Section B.***

In ***Section B***, there was effective use of numerical information in **Question 3 (a)** and **Question 5 (a)**, where data was extracted and manipulated appropriately. The development of points in discussion and evaluation of examples of environmental strategies in specific locations were the weakest aspects of answers in ***Section B***.

Question 3 and ***Question 5*** were popular choices in ***Section B***.

Comments on specific questions

Section A

Question 1

(a) (i) This question was most often correctly answered in terms of the major ecosystem components of soil, vegetation or water. Credit could not be awarded when factors affecting the ecosystem rather than the ecosystem components were stated, or where two types of the same component, for example, red and black mangrove were given.

(ii) In a few excellent answers the information in **Fig. 1.1** was interpreted as a zonation or a transition, showing variation in the mangrove species adapted to survive in the different areas, with red mangrove growing in proximity to the water edge and white mangrove growing on higher ground, at a greater distance from the water. It was noted in these answers that one of the effects of the changing water level on the ecosystem was that the plants would need to be adapted to the specific set of conditions in each area and reference to the different root structures was made. In good answers, the effect of changing water levels on the composition of the soil, either in the amount of water the soil was holding or the saturated waterlogged conditions or the effect on the salinity of the soil was described. In unsuccessful answers, the water level changes were linked more to longer flooding events rather than effects resulting from diurnal changes or short term effects each day.

(b) (i) The decreasing trend in mangrove coverage shown in **Table 1.1** was successfully described in most answers. Further description of the trend was possible in a variety of ways and while some candidates described a slowing rate of decrease over the years, others manipulated data to provide evidence of the slowing rate of decrease, a decrease of 1.86 in the first decade compared to 0.51. Less strong answers simply stated the coverage was higher in 1980 and lower in 2010 and quoted numbers from the table without any manipulation or further exemplification.

(ii) The first part of the calculation, working out the difference in mangrove coverage of 3.56 between 1980 and 2010 was usually correct. The calculation of this difference as a percentage was frequently incorrect. This was sometimes as a result of incorrect substitution**.**

(iii) In effective answers, reasons why coastal water ecosystems such as mangrove ecosystems are at risk were stated and some explanation was offered, for example, an explanation linking global warming to sea level rise and increased flooding, or the cutting of mangrove trees to increased coastal erosion. Some answers lacked specific detail, for example, pollution was often stated as a reason but this was unqualified without the type of pollutant or a source of the contamination and that the ecosystem, the plants or the organisms would be affected without further exemplification. Weak responses just stated the mangroves were at risk because they were decreasing as shown in **Question 1 (b)(i)**.

(c) (i) There was effective use of the photograph to state what was meant by ecosystem restoration. The people replanting the mangrove trees shown in **Fig. 1.2** were referred to and it was suggested that this indicated the repopulation or reintroduction of the native species into a destroyed or a damaged ecosystem so that it is eventually returned to its original state.

(ii) This question was answered well and provided an opportunity to state the benefits of conservation of ecosystems. Benefits were explained effectively and specifically linked to coastal water ecosystems in the most effective answers. For example, the ecological benefit of maintaining mangrove as a habitat for marine species where it acts as a sheltered nursery during early life stages. Conservation of the mangrove was often linked to the economic benefits of increasing fish stocks, thus increasing food supply, providing food for restaurants and increasing tourism in the area. Less well answered responses stated general benefits but did not offer an explanation. Some candidates needed to take care to use the term biodiversity when referring to the variety of living organisms in an ecosystem and the term habitat for the place an organism lives.

(iii) Many answers effectively linked less ecosystem damage to a community being involved in conserving local ecosystems as a direct result of education and increased awareness.

Question 2

(a) (i) A definition which referred to an underground layer of water-bearing rock was communicated in good answers. However, some answers were lacking in specific points relating to an aquifer. Others referred to man made stores of water rather than natural stores.

(ii) Some credit was gained through appropriate interpretation of the information in **Fig. 2.1** to describe the characteristics of the two types of aquifers. Excellent answers elaborated upon the information with further detail showing good knowledge of specific vocabulary such as filtration, percolation, impermeable, permeable and porous rocks. The characteristics of the two types of well which were also shown in **Fig. 2.1** were described, rather than the characteristics of the aquifers. There was some misunderstanding of the term aquifer and as a result relevant information from **Fig. 2.1** was not always interpreted appropriately.

(iii) Many candidates found this question challenging. A few excellent answers showed understanding of water under pressure in the confined aquifer to explain the higher water level in the artesian well and also demonstrated an understanding that the height of the water in the water table well can rise and fall with the variable water table level. In less effective answers the height of the water in the water table well as equivalent to the upper limit of the saturated zone was explained but the higher water level in the artesian well was not explained.

(b) (i) The information in the map in **Fig. 2.2** showing the variation in the thickness of the saturated layer of the Ogallala aquifer was described effectively. Successful answers demonstrated careful analysis of the variation in thickness of the saturated layer and described a spatial distribution. States of North America with adequate groundwater resources and states with limited groundwater reserves were identified. In less successful answers, the different thicknesses of the saturated zone shown in the key were stated without describing how this variation in thickness was distributed in the Ogallala aquifer across the states shown. In some answers, the distribution was explained rather than described, with reference to factors which were then required in answer to the **Question 2 (b)(ii)**.

(ii) Most answers contained accurate suggestions which related to either reducing the input or increasing the output from an aquifer.

(iii) Strong answers showed awareness of the need to balance the inputs and outputs of an aquifer to prevent problems with a diminishing water supply due to over extraction when water is pumped out faster than it can be replenished through recharge. These answers demonstrated good understanding of the need for management to ensure the sustainability of the aquifer and recognised the positive ways in which we manage our environment to preserve quality and quantity of groundwater resources. Effective answers suggested water management strategies which conserved water, reduced waste, reduced demand or prevented contamination. This question was found to be challenging, as some candidates misinterpreted the question and described how the water from the aquifer could be exploited by drilling wells rather than addressing the sustainability aspect of management of groundwater.

Question 3

(a) Very good responses considered the relationship between decreasing biodiversity and increasing human population in detail, with reference to the change in the rate of increase or decrease, during the time intervals chosen. Information from the graph was described and data was carefully extracted, manipulated and used to support the trends reported. In very good answers the slow increase in population growth and a corresponding slow decrease in biodiversity followed by an increased rate of population growth and increased loss of biodiversity were described. An explanation for the data pattern and information presented in the graph, with reasons accounting for the decrease in biodiversity as population increased, were often well developed. Data was used less effectively when only the highest and lowest points of the graph lines were highlighted in a description. In some responses, there was no reference to the data, only to reasons for a decrease in biodiversity as a result of increased human activity, such as hunting, increased deforestation for land development for agriculture, housing or industrialisation, overfishing or pollution. While in contrast, in some responses there was data analysis but no reasons were given. It was necessary to offer a balanced answer where both data interpretation and reasons are required.

(b) This question was approached in a variety of ways. In the strongest responses, ways of increasing production of food and the use of other resources by the human population without negatively impacting upon the environment through the sustainable use of resources were explored. Suggestions to reduce the ecological footprint were considered, for example sustainable agricultural practices, the use of renewable resources and decreased consumption of resources. In good answers, it was suggested how humans could also have a positive impact on biodiversity by conservation efforts to reduce the destruction of ecosystems. Human activity was often presented only in a negative light, by emphasising the pollution, exploitation and misuse of resources as outlined in **Question 3 (a)**, resulting in decreasing biodiversity. In these answers, it was suggested that a reduction of such activities would help to prevent further decreases in biodiversity, for example through laws to ban hunting, fishing restrictions to reduce overfishing or waste management to reduce contamination of the environment. The weakest aspect of answers was the limited use of specific examples to support the argument being developed.

Question 4

(a) The most effective answers described specific changes in the extent of the Aral Sea as shown in the maps in **Fig. 4.1** for each of the years shown. In these answers the map was used to estimate the reduced area of sea. Specific changes such as the fragmentation of the Aral Sea into the North Aral Sea and the South Aral Sea were noted and the significance of the building of the Kok-Aral dam in 2005 was considered. Discerning candidates noted that by 2015, the North Aral Sea had

started to increase in extent. In these responses, effective interpretation of information presented in the map was made to suggest reasons for these changes. For example, the increased extraction of water from rivers for irrigation, increased diversion of water in canals and the unsustainable use of water by settlements in the area. In less effective answers, the overall decrease in the extent of sea between 1957 and 2015 was described in general and there was little use of the information to suggest reasons, which were often limited to suggesting climate change and increasing aridity and drought.

(b) The most successful responses included an introduction explaining the need to protect a country's water supply and considered some of the possible issues and conflicts. In general, the use of examples to illustrate the strategies was weak. Some examples focused more on the issues rather than solutions. A full range of strategies relating to the protection of water resources from contamination; the sustainable use of water resources; the improvement in water provision through such means as desalination and water treatment, together with critical and supportive evaluations of these environmental management policies characterised the most effective answers.

Question 5

(a) In effective answers, data was extracted to support a description of population changes. Overall changes were described in detail, for both white and black rhinoceros species. The dramatic decrease and subsequent increase for the black rhinoceros species and the continuous increase for the white rhinoceros species were noted from **Fig. 5.1** as well as the point at which the population of white rhinoceros started to rise above the black rhinoceros population. The extent of the decreases or increases was revealed through the use of supporting data accurately extracted from **Fig. 5.1** and used to show the change in rhinoceros population during the time period. Calculations were used to emphasise the dramatic decline in the black rhinoceros numbers, in the growth rate of the populations to show the slow progress in restoring population numbers, or to give the ratio of black to white rhinoceros or percentage decreases.

Less effective use of data highlighted only the highest and lowest points of the bar chart and referred only to black rhinoceros decreasing and white rhinoceros increasing. Often, the small increase in the black rhinoceros was omitted. Data was quoted but the differences to show the extent of the increases and decreases were not calculated. There was no reference to the data at all in some responses. Reasons for the changes in the population size were suggested in most answers and most commonly decreases were explained by reference to habitat loss as a result of deforestation for land development and illegal poaching. Other factors determining population size were also considered such as inter-specific competition and disease. Protection of the species through the establishment of national parks, conservation areas and wildlife management strategies were considered in relation to the increase in numbers.

(b) In general, assessments were balanced with both mechanisms for the conservation of ecosystems; international protocols and local policies considered. The weakest aspect was in the use of examples as there were few examples of international protocols or examples of local action discussed. The example of the rhinoceros was effectively used to support an assessment of the statement provided in the question.

ENVIRONMENTAL MANAGEMENT

Paper 8291/22
Paper 22

Key messages

- In both ***Section A*** and ***Section B***, when considering source material, candidates should select and use relevant information and data to support answers.
- Data extracted should be manipulated, and not simply quoted from tables, graphs and bar charts, to carefully analyse information.
- Working should be shown in calculations.
- Candidates need to understand and act upon the command word in each question, for example, to describe: the main points need to be stated and should include reference to associated observations.
- Subject specific vocabulary should be used in answers and terms defined appropriately.
- In ***Section B***, candidates should use specific examples to allow for pertinent evaluation of the strategies used in environmental management.

General comments

In ***Section A***, candidates performed equally well in **Questions 1** and **2**, and in the more successful answers there was good use of information extracted from source material. In general, candidates performed better in ***Section A*** than in ***Section B.***

In ***Section B,*** there was some accurate use of subject specific vocabulary and effective use of data in **Questions 3(a), 4(a)** and **5(a).** Development of points in discussion and evaluation of examples of environmental strategies in specific locations were the weakest aspects of some answers in ***Section B***.

Question 4 and **Question 5** were popular choices in ***Section B***.

Comments on specific questions

Section A

Question 1

(a) (i) This question was usually answered correctly. Some answers were not specific enough as they referred generally to a rural source rather than specifically to rural groundwater. In other responses, sewage was incorrectly chosen as the answer from **Fig. 1.1** as this had the highest percentage value in the table, but this referred to phosphorus compounds rather than nitrogen compounds.

(ii) This question was generally answered with a range of appropriate sources. Suggestions for examples included nitrates from fertilisers used in urban gardens and parks; phosphates from soaps and detergents used in houses or in car washes; air pollution from vehicles and factories, linked to chemicals dissolving in precipitation and falling on urban areas and running into surface drains.

(iii) The calculation was usually correct except when there was incorrect addition of the relevant column information or an incorrect selection of information from the table in **Fig. 1.1**. Instead of selecting the appropriate information for rural run-off, all of the data in the entire column was used to give column totals. Other incorrect answers resulted from an addition of the two column totals instead of a subtraction.

(iv) In successful answers, it was recognised that excess nutrients not absorbed by crops plants or trees would be dissolved in soil water, the minerals would then be leached, water would percolate to groundwater and groundwater would flow to the lake. In unsuccessful answers, groundwater flow to the lake was omitted and these answers referred only to surface run-off, washing away nutrients from cropland, forest and pasture and water running off the land directly into the lake. This did not explain the high percentage of nutrients entering the lake from rural groundwater. Subject specific vocabulary such as run-off, infiltration, leaching and percolation needed to be differentiated accurately in answers.

(b) In general, this question was well answered. The term eutrophication was used and linked stages in this process were correctly outlined in a sequence to show the effects of excess nutrients entering a lake. A common error was to omit the process of decomposition. Information linking the death of algae and underwater plants, their decay, an increase in decomposer organisms using oxygen in respiration, reducing the oxygen concentration in the water and resulting in oxygen depletion was often missing from the sequence.

(c) Candidates were very knowledgable about management strategies to reduce pollution in water stores. Strategies suggested were wide ranging and covered a variety of sources of lake pollution. Following on from eutrophication in the previous question, answers focused on a reduction in the input of fertilisers to the lake through the use of more sustainable agricultural methods with ideas such as using less fertilisers, using crop rotation and precision irrigation. The use of buffer zones with tree planting adjacent to the lakes to reduce surface run-off and to absorb nutrients in run-off was also suggested. Other techniques to reduce the amount of waste water entering the lake through water recycling and the reuse of grey water, diverting sewage pipes away from the lake and the maintenance of sewage pipes to prevent accidental leakage are examples of some of the management strategies. Less effective answers were limited to reducing run-off to reduce pollution entering the lake but without further elaboration.

Question 2

(a) (i) Appropriate information from **Fig. 2.1** was used to describe the distribution of the tundra biome effectively.

(ii) This was usually well answered except when the question was misinterpreted and a description of the distribution of the biome was stated instead of factors influencing the distribution.

(iii) In effective answers, there was good use of the information in the map in **Fig. 2.2** to support the view that the polar bear is at risk of extinction. In the strongest responses, the state of the populations across the areas was described and supported with reference to population data. Less successful answers omitted specific population data but gave some assessment of the extent of the decline across the areas. The least effective answers simply stated that the populations were declining without any specific reference to areas or to population data.

(b) This question was successfully answered by highlighting organisms in the food chain and suggesting how these populations of organisms may be affected as a result of a decline in polar bears in the region. The strongest answers supported the changes to the food chain with use of specific vocabulary relating to feeding relationships such as primary, secondary, tertiary or quaternary consumers, predation, prey, competition and food availability. The question was occasionally misinterpreted and a decrease in polar bear numbers was explained rather than the effect of a decrease in polar bears on the food web.

(c) An international protocol was defined and a specific example was stated in good answers. In the strongest responses, a protocol was successfully linked directly to the management of the tundra biome. Good answers focused mainly on protocols reducing greenhouse emissions to offset the consequences of global warming and elaborated upon the significance of this for the tundra biome. Many answers commented on aspects of exploitation of the tundra biome but solutions were not linked to international protocols.

Question 3

(a) In the most effective answers, relevant information from both data sources was selected and organised to effectively communicate a response. The relationship between freshwater availability

and the percentage contribution made by regions to the supply of desalinated water globally was interpreted from the data and information presented in the table and the pie chart in **Fig. 3.1**. The general trend of decreasing availability of freshwater resources and a higher contribution to the supply of desalination was supported with reference to the data and anomalies within the general trend were also identified and reasons for these were suggested. There was less effective use of the data when only the lowest value for fresh water availability in the table was linked to the highest percentage of desalination in the pie chart. When there was no reference to the data or information, the reasons stated were generalised to population density and economic development and were not linked to specific regions.

(b) In all responses, both advantages and disadvantages were developed to give a balanced response with reference to, for example, the provision of potable water where limited sources of freshwater are available, sustainability, employment and economic development. These were balanced with disadvantages such as the cost, and the ecological disruption. Examples of the application of these advantages and disadvantages in a specific location were not included in the majority of responses; this was the weakest aspect of answers.

Question 4

(a) In excellent answers, the overall trend of decreasing forest reserves was identified, and regional trends were compared and contrasted. Regions where there was a continuous decrease and regions where there was a continuous increase were also identified from **Fig. 4.1**. The extent of the decreases or increases was revealed through the use of supporting data accurately extracted from **Fig. 4.1** and used to calculate the change in forest reserves during the time period. Reasons for the increases were most commonly linked to afforestation and the development of protected forest reserves, while decreases were explained by reference to deforestation linked to population increase and the growing demand for land to be cleared for development. The use of data was less effective when only the highest and lowest points of the bar chart were highlighted. Data for the changes was stated but the differences to show the extent of the increase and decrease were not calculated. In some answers there was no reference to the data while in others no reasons were suggested. This illustrates the need to offer a balanced answer when both data interpretation and reasons are required.

(b) This question was generally well answered except where more than one ecosystem was chosen or where no specific example was stated. Examples used to assess the effectiveness of conservation methods included ecosystems such as the tropical rainforest ecosystem of Amazonia or the coral reef ecosystems of the Great Barrier Reef. In addition to using a well-chosen example of one of the ecosystems studied, the incorporation of critical and supportive evaluations of the environmental management policies characterised the responses of the strongest candidates.

Question 5

(a) In excellent answers, the trends in **Fig. 5.1** were identified to reveal not only the overall decrease or an overall increase in predicted water demand in MEDCs, BRICS and LEDCs, but in addition within sector trends were also identified to show changing demands in the agriculture, domestic, electricity and manufacturing sectors. There was careful and accurate extraction of data to support the trends identified and reasons were suggested. Less detailed answers compared only the overall decrease or an overall increase in predicted water demand in MEDCs, BRICS and LEDCs and this was reflected in the range and quality of reasons given in the answer. Those candidates who showed no use of data in their responses could gain only limited levels of credit.

(b) Effective responses illustrated population growth and the growing demand for water on the quality and quantity of natural water supplies through the use of pertinent examples such as the Aral Sea and Ogallala. Answers were wide ranging and balanced between the impact on quantity of water and the impact on quality of water. In less effective responses, there was a tendency to repeat information about the increasing demand for water as outlined in **Question 5(a)** rather than concentrating on the impact on the quality and quantity of water supplies. The weakest aspect was the provision of examples, as these were infrequently used to illustrate the answer and responses were often unbalanced with a focus on one aspect only, for example, eutrophication and river pollution.

ENVIRONMENTAL MANAGEMENT

Paper 8291/23
Paper 21

Key messages

- In both ***Section A*** and ***Section B***, when considering source material, candidates should select and use relevant information and data to support answers.
- Data extracted should be manipulated, and not simply quoted from tables, graphs and bar charts, to carefully analyse information.
- Working should be shown in calculations.
- Candidates need to understand and act upon the command word in each question, for example, to describe: the main points need to be stated and should include reference to associated observations.
- Subject specific vocabulary should be used in answers and terms defined as appropriate.
- In ***Section B***, candidates should use specific examples to allow for pertinent evaluation of the strategies used in environmental management.

General comments

In ***Section A***, candidates performed equally well in **Questions 1** and **2**. There was good use of information from the source material in ***Section A.*** Overall, candidates performed better in ***Section A*** than ***Section B.***

In ***Section B***, there was effective use of numerical information in **Question 3 (a)** and **Question 5 (a)**, where data was extracted and manipulated appropriately. The development of points in discussion and evaluation of examples of environmental strategies in specific locations were the weakest aspects of answers in ***Section B***.

Question 3 and ***Question 5*** were popular choices in ***Section B***.

Comments on specific questions

Section A

Question 1

(a) (i) This question was most often correctly answered in terms of the major ecosystem components of soil, vegetation or water. Credit could not be awarded when factors affecting the ecosystem rather than the ecosystem components were stated, or where two types of the same component, for example, red and black mangrove were given.

(ii) In a few excellent answers the information in **Fig. 1.1** was interpreted as a zonation or a transition, showing variation in the mangrove species adapted to survive in the different areas, with red mangrove growing in proximity to the water edge and white mangrove growing on higher ground, at a greater distance from the water. It was noted in these answers that one of the effects of the changing water level on the ecosystem was that the plants would need to be adapted to the specific set of conditions in each area and reference to the different root structures was made. In good answers, the effect of changing water levels on the composition of the soil, either in the amount of water the soil was holding or the saturated waterlogged conditions or the effect on the salinity of the soil was described. In unsuccessful answers, the water level changes were linked more to longer flooding events rather than effects resulting from diurnal changes or short term effects each day.

(b) (i) The decreasing trend in mangrove coverage shown in **Table 1.1** was successfully described in most answers. Further description of the trend was possible in a variety of ways and while some candidates described a slowing rate of decrease over the years, others manipulated data to provide evidence of the slowing rate of decrease, a decrease of 1.86 in the first decade compared to 0.51. Less strong answers simply stated the coverage was higher in 1980 and lower in 2010 and quoted numbers from the table without any manipulation or further exemplification.

(ii) The first part of the calculation, working out the difference in mangrove coverage of 3.56 between 1980 and 2010 was usually correct. The calculation of this difference as a percentage was frequently incorrect. This was sometimes as a result of incorrect substitution**.**

(iii) In effective answers, reasons why coastal water ecosystems such as mangrove ecosystems are at risk were stated and some explanation was offered, for example, an explanation linking global warming to sea level rise and increased flooding, or the cutting of mangrove trees to increased coastal erosion. Some answers lacked specific detail, for example, pollution was often stated as a reason but this was unqualified without the type of pollutant or a source of the contamination and that the ecosystem, the plants or the organisms would be affected without further exemplification. Weak responses just stated the mangroves were at risk because they were decreasing as shown in **Question 1 (b)(i)**.

(c) (i) There was effective use of the photograph to state what was meant by ecosystem restoration. The people replanting the mangrove trees shown in **Fig. 1.2** were referred to and it was suggested that this indicated the repopulation or reintroduction of the native species into a destroyed or a damaged ecosystem so that it is eventually returned to its original state.

(ii) This question was answered well and provided an opportunity to state the benefits of conservation of ecosystems. Benefits were explained effectively and specifically linked to coastal water ecosystems in the most effective answers. For example, the ecological benefit of maintaining mangrove as a habitat for marine species where it acts as a sheltered nursery during early life stages. Conservation of the mangrove was often linked to the economic benefits of increasing fish stocks, thus increasing food supply, providing food for restaurants and increasing tourism in the area. Less well answered responses stated general benefits but did not offer an explanation. Some candidates needed to take care to use the term biodiversity when referring to the variety of living organisms in an ecosystem and the term habitat for the place an organism lives.

(iii) Many answers effectively linked less ecosystem damage to a community being involved in conserving local ecosystems as a direct result of education and increased awareness.

Question 2

(a) (i) A definition which referred to an underground layer of water-bearing rock was communicated in good answers. However, some answers were lacking in specific points relating to an aquifer. Others referred to man made stores of water rather than natural stores.

(ii) Some credit was gained through appropriate interpretation of the information in **Fig. 2.1** to describe the characteristics of the two types of aquifers. Excellent answers elaborated upon the information with further detail showing good knowledge of specific vocabulary such as filtration, percolation, impermeable, permeable and porous rocks. The characteristics of the two types of well which were also shown in **Fig. 2.1** were described, rather than the characteristics of the aquifers. There was some misunderstanding of the term aquifer and as a result relevant information from **Fig. 2.1** was not always interpreted appropriately.

(iii) Many candidates found this question challenging. A few excellent answers showed understanding of water under pressure in the confined aquifer to explain the higher water level in the artesian well and also demonstrated an understanding that the height of the water in the water table well can rise and fall with the variable water table level. In less effective answers the height of the water in the water table well as equivalent to the upper limit of the saturated zone was explained but the higher water level in the artesian well was not explained.

(b) (i) The information in the map in **Fig. 2.2** showing the variation in the thickness of the saturated layer of the Ogallala aquifer was described effectively. Successful answers demonstrated careful analysis of the variation in thickness of the saturated layer and described a spatial distribution. States of North America with adequate groundwater resources and states with limited groundwater reserves were identified. In less successful answers, the different thicknesses of the saturated zone shown in the key were stated without describing how this variation in thickness was distributed in the Ogallala aquifer across the states shown. In some answers, the distribution was explained rather than described, with reference to factors which were then required in answer to the **Question 2 (b)(ii)**.

(ii) Most answers contained accurate suggestions which related to either reducing the input or increasing the output from an aquifer.

(iii) Strong answers showed awareness of the need to balance the inputs and outputs of an aquifer to prevent problems with a diminishing water supply due to over extraction when water is pumped out faster than it can be replenished through recharge. These answers demonstrated good understanding of the need for management to ensure the sustainability of the aquifer and recognised the positive ways in which we manage our environment to preserve quality and quantity of groundwater resources. Effective answers suggested water management strategies which conserved water, reduced waste, reduced demand or prevented contamination. This question was found to be challenging, as some candidates misinterpreted the question and described how the water from the aquifer could be exploited by drilling wells rather than addressing the sustainability aspect of management of groundwater.

Question 3

(a) Very good responses considered the relationship between decreasing biodiversity and increasing human population in detail, with reference to the change in the rate of increase or decrease, during the time intervals chosen. Information from the graph was described and data was carefully extracted, manipulated and used to support the trends reported. In very good answers the slow increase in population growth and a corresponding slow decrease in biodiversity followed by an increased rate of population growth and increased loss of biodiversity were described. An explanation for the data pattern and information presented in the graph, with reasons accounting for the decrease in biodiversity as population increased, were often well developed. Data was used less effectively when only the highest and lowest points of the graph lines were highlighted in a description. In some responses, there was no reference to the data, only to reasons for a decrease in biodiversity as a result of increased human activity, such as hunting, increased deforestation for land development for agriculture, housing or industrialisation, overfishing or pollution. While in contrast, in some responses there was data analysis but no reasons were given. It was necessary to offer a balanced answer where both data interpretation and reasons are required.

(b) This question was approached in a variety of ways. In the strongest responses, ways of increasing production of food and the use of other resources by the human population without negatively impacting upon the environment through the sustainable use of resources were explored. Suggestions to reduce the ecological footprint were considered, for example sustainable agricultural practices, the use of renewable resources and decreased consumption of resources. In good answers, it was suggested how humans could also have a positive impact on biodiversity by conservation efforts to reduce the destruction of ecosystems. Human activity was often presented only in a negative light, by emphasising the pollution, exploitation and misuse of resources as outlined in **Question 3 (a)**, resulting in decreasing biodiversity. In these answers, it was suggested that a reduction of such activities would help to prevent further decreases in biodiversity, for example through laws to ban hunting, fishing restrictions to reduce overfishing or waste management to reduce contamination of the environment. The weakest aspect of answers was the limited use of specific examples to support the argument being developed.

Question 4

(a) The most effective answers described specific changes in the extent of the Aral Sea as shown in the maps in **Fig. 4.1** for each of the years shown. In these answers the map was used to estimate the reduced area of sea. Specific changes such as the fragmentation of the Aral Sea into the North Aral Sea and the South Aral Sea were noted and the significance of the building of the Kok-Aral dam in 2005 was considered. Discerning candidates noted that by 2015, the North Aral Sea had

started to increase in extent. In these responses, effective interpretation of information presented in the map was made to suggest reasons for these changes. For example, the increased extraction of water from rivers for irrigation, increased diversion of water in canals and the unsustainable use of water by settlements in the area. In less effective answers, the overall decrease in the extent of sea between 1957 and 2015 was described in general and there was little use of the information to suggest reasons, which were often limited to suggesting climate change and increasing aridity and drought.

(b) The most successful responses included an introduction explaining the need to protect a country's water supply and considered some of the possible issues and conflicts. In general, the use of examples to illustrate the strategies was weak. Some examples focused more on the issues rather than solutions. A full range of strategies relating to the protection of water resources from contamination; the sustainable use of water resources; the improvement in water provision through such means as desalination and water treatment, together with critical and supportive evaluations of these environmental management policies characterised the most effective answers.

Question 5

(a) In effective answers, data was extracted to support a description of population changes. Overall changes were described in detail, for both white and black rhinoceros species. The dramatic decrease and subsequent increase for the black rhinoceros species and the continuous increase for the white rhinoceros species were noted from **Fig. 5.1** as well as the point at which the population of white rhinoceros started to rise above the black rhinoceros population. The extent of the decreases or increases was revealed through the use of supporting data accurately extracted from **Fig. 5.1** and used to show the change in rhinoceros population during the time period. Calculations were used to emphasise the dramatic decline in the black rhinoceros numbers, in the growth rate of the populations to show the slow progress in restoring population numbers, or to give the ratio of black to white rhinoceros or percentage decreases.

Less effective use of data highlighted only the highest and lowest points of the bar chart and referred only to black rhinoceros decreasing and white rhinoceros increasing. Often, the small increase in the black rhinoceros was omitted. Data was quoted but the differences to show the extent of the increases and decreases were not calculated. There was no reference to the data at all in some responses. Reasons for the changes in the population size were suggested in most answers and most commonly decreases were explained by reference to habitat loss as a result of deforestation for land development and illegal poaching. Other factors determining population size were also considered such as inter-specific competition and disease. Protection of the species through the establishment of national parks, conservation areas and wildlife management strategies were considered in relation to the increase in numbers.

(b) In general, assessments were balanced with both mechanisms for the conservation of ecosystems; international protocols and local policies considered. The weakest aspect was in the use of examples as there were few examples of international protocols or examples of local action discussed. The example of the rhinoceros was effectively used to support an assessment of the statement provided in the question.

ENVIRONMENTAL MANAGEMENT

Paper 8291/03
Centre-based Assessment

This year's report falls into two sections:

- General comments and candidate performance report
- three appendices covering Cambridge Assessment administrative procedures.

General comments

The November 2018 entry was marginally higher than the entries received in previous years. The range of marks out of 40 was between 10 and 40; most were in the 20 to 35 range which is very similar to the previous November series. Where candidates selected the same or a similar topic, there appeared no issue of plagiarism derived from candidates, indicating centres are providing good guidance in this area.

The candidate reports that achieved marks in the 34 to 40 mark range were well structured and provided evidence of collected and collated primary data, often combining this with secondary data sources. Marks were lost through not evidencing use of a suitable data analysis statistical tool, or not providing a clear and reflective evaluation of the investigation i.e. strengths or weaknesses of the study in terms of their methodology.

It is still without doubt that the best reports are derived from the collection and collation of primary data obtained from either field investigations or laboratory work. A significant number of the higher achieving candidates clearly demonstrated the use of combining secondary data in conjunction to primary data, when discussing and forming conclusions to their study, thus evidencing a very rigorous report.

There also appears to be a good correlation in achieving a high mark with those candidates that have submitted detailed sources of information in support of their environmental proposals, including the submission of a reasonably detailed and considered methodology as evidenced in their outline proposal form, prior to undertaking the investigation.

Issues are as follows:

- There are still a few centres that are late in dispatching of candidate reports. This is unfair on those centres that are prompt.
- Leniency, particularly in assessment criteria C2 (a, b and e) and C3 (a and b) is common; 2 marks being awarded when 1 is better.
- Credit is still being given for criteria not actually present in project reports. No credit can be given for use of a statistical tool when one has not been used, nor can 2 marks be given for conclusions that do not relate to the candidates specific data.

There are many project reports now evidencing an excellent approach towards organisation and structuring of their coursework in a logical order: introduction, methods (justified), results and analysis, conclusion and evaluation. Many candidates use these stages as section or chapter headings. It is extremely important that centres as well as candidates recognise the difference between a research report and an extended essay, given the range of assessment criteria, and importantly C2 c.

Although this is a repeat of previous reports, please note the following that candidates should consider.

- Will the hypothesis or question actually yield viable results?
- Are the methods realistic, practical and relevant; 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 the conclusion, sum up and relate results to the original hypothesis or question?
- Has there been an evaluation in terms of both successful features and limitations; what can be done to improve the work?

Finally, from an administrative perspective, centres should check and ensure the correct mark from the Coursework summary form has been entered correctly on the MS1 form for each candidate. This should be a mark out of 40.

Comments on assessment criteria

Skill C1

Most candidates performed well in this skill area, and there was often an excellent level of detail demonstrated surrounding the background knowledge in relation to the hypothesis or research question.

Either as the project title or as part of an introduction, hypotheses or questions were stated by most candidates, frequently being clearly written. This is important as a significant number of candidates will conclude that their hypothesis was correct, yet there is no evidence anywhere in the script of a research question or hypothesis. Candidates invariably achieving a high mark often include the location of the hypothesis within a contents page.

Stating and justifying a methodology was, in the main, adequate. Good quality research requires the formulation of a plan, detailing research sites, equipment, expected data and how it will be collated and presented. Candidates need to recognise that a detailed methodology is crucial when testing their hypothesis or answering their research question; without this element, there is the risk that the report will become an extended essay, thereby interfering with the achievement of both C1 and C2 criteria.

Where the reports had a limited methodology, which was often a brief list without any explanation or justification; it can be difficult to judge whether or not their methodology would be effective in testing their hypothesis or answering their question.

Skill C2

Achievement in C2 was very similar to previous sessions.

In achieving full marks for C2a candidates need to make sure all graphs and tables are clearly presented, this includes labelling all axes as well as providing a title. Graphs were sometimes inappropriate for the type of data to be represented; line graphs are suited to continuous data and bar graphs for discrete data. Graphs should have axes containing labelled units and both lines and bars should be easily interpreted.

There are a limited number of candidate reports that are better described as extended essays and contain very little data presented in the form of graphs and/or tables. As a result, it was difficult to achieve marks in any criteria that required reference to data; this also negating use of a statistical tool. Often these reports are heavily reliant upon photographic evidence with a limited amount of quantitative data or any evidenced. This factor reduces the marks available for the associated criteria. It is better that photographic evidence supplements other forms of information.

The use of a statistical tool is still a weakness. There is a difference between statistical methods that are used to describe data and statistical tools that are used to analyse data. Candidates need to consider the nature of the data and select an appropriate statistical test chosen. A simple mean is unlikely to yield appropriate analysis unless it is backed up with graphical representation and/or further processing. Unfortunately some centres award this mark when there is no evidence at all of a statistical tool.

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

Skill C3

It still continues to be the case, that this important skill frequently forms the weakest part of a candidate's work. The main weakness in C3a, the conclusion, is a lack of reference to the data presented in the report. C3b is also often very limited, as only a small number of candidates referred to related environmental

management principles; yet the full 2 marks were given when 1 mark was appropriate. This element also needs reference to the actual data within the report.

Some centres still need to inform their candidates that the evaluation needs to be a brief summary of those things that went well and not so well i.e. success and limitations. There is still confusion between an evaluation and a conclusion. Some candidates still appear to evaluate their secondary data, instead of appraising their methodology (success and limitations of the methodology). A relatively small number still do not include an evaluation for criteria C3c. It would be greatly appreciated if centre staff can make certain candidates are aware of these expectations, as with all assessment criteria.

Concluding comments

The evidence, with regard to candidate report submissions, demonstrates a clear and enthusiastic engagement with this element of the Environmental Management syllabus in which candidates are given the opportunity to research a topic of their choice. It is extremely pleasing to see that the selection of topics continues to focus on some very key and current environmental issues at a local level, such as the issue of plastic waste, or issues of water pollution in relation to excessive fertiliser application.

Candidates must be given very close guidance in respect of their project title as a significant number try and review global data which is extremely challenging given the assessment criteria and word count. The title can be too broad in scope, thereby limiting the testing of the hypothesis effectively. Occasionally more than one hypothesis was evidenced, and candidates need to be aware that this may have an impact in respect of their methodology being able to securely test all hypotheses. It is the centres' responsibility to provide close guidance at the project proposal stage.

In addition to the topic, there is the opportunity to learn some research techniques and put them into practice. As in previous sessions the better topics and final reports are derived from locally based research and the utilisation of primary data.

I would very much like to thank all teachers and assessors for the work they undertake in making this element of the examination a success, and also for compliance in the majority of cases to the administrative requirements of Cambridge International.

Appendix 1 is concerned with how centres select their sample for external moderation.
It is not necessary for centres with over ten candidates to send all candidates, although extra can be requested by the external Moderator.

Option	Details
Option A: The centre selected sample. It is essential that the marks of candidates from different teaching groups within each centre are moderated internally and the moderated mark out of 40 is entered onto the MS1, candidate Record Card and Coursework Assessment Summary Form.	**You select the sample, according to the criteria below:** • 1 – 10 entries: all candidates • 11 – 50 entries: 10 candidates • 51 – 100 entries: 15 candidates • 101 – 200 entries: 20 candidates • Over 200 entries: 10% of candidates The sample should include a candidate with the highest mark and a candidate with the lowest mark in the cohort, with the remaining candidates spread evenly across the mark range. **All** work which contributed to the candidates' final mark must be included. If more than one teacher has assessed the work, the sample should include an even number of examples of the marking of each teacher. Send us the sample using a method that provides a tracking facility (i.e. a reputable courier), to arrive by the deadline specified on the previous page. We reserve the right to request additional samples.

Appendix 2

All centres must submit the following completed forms with their sample:

- An individual candidate Record Card for each candidate with a mark out of 20, doubled to be out of 40. Comments should be made so that the external Moderator can clearly determine where and why credit has been given.
- A Coursework Assessment Summary Form with candidates inserted in candidate number order as in the MS1.
- A MS1 form covering all candidates entered for the examination Marks out of 40 should be clearly entered and absent candidates given abs or A.

The syllabus contains a detailed amplification of these points.

Appendix 3

For the May/June session, centre marks should be submitted by 30th April and the sample should be dispatched at the same time. All sample reports should be with Cambridge Assessment no later than 14th May.

For the November session, centre marks should be submitted by 31st October and report at the same time so that they are with Cambridge Assessment no later than 14th November.