ENVIRONMENTAL MANAGEMENT

Paper 8291/11
Paper 11

Key messages

- Candidates should include subject content in their responses and use technical vocabulary where appropriate.
- In ***Section A***, candidates should consider the command word for the question, using it to instruct them on how to write their response.
- In ***Section B***, candidates should combine descriptions of the data provided with explanations of the processes involved.
- In ***Section B***, candidates could develop their responses by thinking carefully about the question asked and providing a balanced response to it.
- A significant number of candidates attempted all three of the optional questions and therefore did not have enough time to develop their answer and achieve the higher levels available.

General comments

There was a good response to all questions on the paper with candidates scoring slightly higher in ***Section B*** compared to ***Section A***. Candidates generally found **Question 2** (the atmosphere) easier than **Question 1** (the lithosphere). Topics that were found most challenging were discussing seismic evidence, explaining atmospheric pollution and explaining strategies to manage noise levels.

In ***Section B***, **Questions 3** and **4** were both much more popular choices compared to **Question 5**. Candidates used the data provided very well in **Question 4**, the data could have been interpreted further in **Question 3** and candidates could have added further explanation to their description of the data in **Question 5**. Candidates who considered the wording of the question and selected specific examples and ideas which linked to what they were being asked achieved a higher level of credit compared to those who answered with a general environmental management response.

Comments on specific questions

Section A

Question 1

(a) The vast majority of candidates were able to label the mantle and crust. A few successfully labelled the asthenosphere, just below the crust. Credit was also given to candidates who labelled the outermost layer as the lithosphere.

(b) (i) There were many good responses to this question where candidates included a detailed description of the paths the seismic waves take. A common observation was that the waves spread out from the focus, as was the identification that the P waves refracted or changed direction. Many candidates noted that P waves were able to travel through the core and S waves could not. Some candidates could have improved their answers by noting that the command word was 'describe', and that **Fig. 1.2** should be used, as those who did not gain the credit often gave explanations for the process rather than descriptions.

(ii) Stronger answers were characterised by statements which explained why seismic waves could be used to provide evidence of the Earth's internal structure and what structures the waves could identify. For example, some candidates were able to link the travel time of waves to the density of

the material they travel through, the idea that the pattern of seismic waves allowed layers within the Earth to be identified. Other strong answers identified that the large S wave shadow zone helped to identify the size of the core. Responses could be improved by including an explanation of the process, considering why the pattern occurs.

(c) (i) Many candidates were awarded full credit for this question. Candidates referred to **Fig.1.3**, identifying that the proximity to the major plate boundary was a factor which led to an earthquake occurring at **X**. Some candidates developed their answer further and included the information that there needed to be sudden movement or a shift of movement along the plate boundary.

(ii) Some candidates gained full credit for this question by describing the process of the sea floor moving which would lead to the displacement of the water above. Others gained by identifying that the movement occurred under the water. Some candidates could improve their answer by being more precise; some discussed the earthquake happening in the water rather than under the water.

(iii) Candidates who were successful responded to the idea that the warning was given a very short time before the earthquake; candidates needed to develop their answers further than just evacuation. Responses that discussed the strategies of accessing shelters, reaching higher ground or moving away from specific hazards which may fall were awarded the credit. Very few candidates considered the possibility of shutting down industrial or transport systems.

(iv) Candidates who responded well to this question focused on their description of just two strategies. Some candidates limited their responses by providing a list of strategies without describing any of them. Strong responses gave a detailed description of how buildings could be modified or designed with a description of how this works, for example cross bracing in tall buildings increasing the strength of the building.

Question 2

(a) (i) Many candidates were able to correctly name atmospheric pollutants which would be produced in the image. Common responses included carbon dioxide, carbon monoxide and sulfur dioxide.

(ii) Few candidates were able to answer this question in a clear and concise way. Many responses discussed the carbon dioxide emissions from the car rather than the nitrogen oxides and VOCs. A few answers went on to state that energy from the sun was needed to initiate the reaction, although some tried to include this by stating that the chemicals mixed with sunlight. Few candidates completed the description by explaining that a chemical reaction had to occur as a new product is made that results in the ground level ozone.

(b) (i) Virtually all candidates who attempted to complete the graph in **Fig. 2.2** did this accurately and were awarded the credit. A large proportion of candidates did not attempt this question and moved straight on to the next text-based answer.

(ii) Virtually all candidates were awarded the credit here and on the rare occasions where this was not the case, candidates had stated the number of days rather than the year.

(iii) Candidates were very strong at being able to suggest health reasons linked to air pollution and a wide range of responses was provided.

(vi) There was a wide range of responses to this question. Candidates who gained most credit were those who discussed city **A** and city **B** specifically and identified which city each of their statements linked to. For example, candidates may have suggested that city **B** has a higher population or city **B** is more industrial with a greater number of factories. Responses which included general comments on why places may be more or less polluted could not be awarded the credit as the link to city **A** or city **B** was not present.

(c) (i) Generally, candidates answered this question well, with many referring to the diagram and describing a range of observations for the noise levels in Las Vegas. A common comment which needed developing for credit to be awarded was that the noise was loudest at the centre of Las Vegas, although the map showed that the loudest noise level was just south of the centre of Las Vegas.

(ii) Candidates approached this question in a variety of ways; some answers were quite vague and suggested ideas which would not be practical like having no roads or moving the whole city. Stronger responses discussed the idea of a curfew, building airports outside the city limits, selecting cars which produced less noise and using congestion charges to prevent cars entering the city centre. Other common responses included using double glazing or soundproofing in homes.

Section B

Question 3

(a) **Fig. 3.1** shows data on the carbon emissions created from traditional internal combustion engine vehicles compared to electricity powered cars. Some mid-level answers focused on comparing the emissions for each type of car and considered the source of fuel in their comparison. The strongest answers included the connection between the carbon emissions and the enhanced greenhouse effect. Other strong answers developed their ideas further and discussed whether electric cars were available in all locations, the potential environmental impact of the battery and whether electric cars would be suitable for all users.

(b) Candidates wrote some excellent extended responses to this question where a range of resources which are extracted from the lithosphere were discussed. Well-structured responses looked at scenarios where resources had been managed well which included separating and recycling metals, making products from recycled materials, more efficient use of energy resources by insulating buildings and using renewable energy sources in place of extraction of fossil fuels. Candidates also included discussions on how national park status would prevent the extraction of minerals in certain sites. Candidates contrasted the successful strategies with situations where resources had not been well managed: increased consumerism, disposable items, advancing technology requiring upgrades, excessive use of fossil fuels in transport and industrial demands and extraction from tar sands were all discussed. Many candidates concluded with the idea that a sustainable approach was needed and this would need to be very prompt to have an impact. Candidates who needed to develop their answers further may have discussed renewable energy strategies linking these to the effect on the atmosphere rather than linking them to reducing the amount of fossil fuels being extracted from the lithosphere.

Question 4

(a) Candidates were able to identify many reasons for the differences between the climate experienced at the four cities in South America. Many candidates could link the differing conditions displayed in the table to the information provided on the map. Common ideas included descriptions of the warm current on the east coast bringing warm moist air causing high precipitation in Salvador, and the cold current on the west coast bringing cold and dry conditions resulting in low levels of precipitation experienced in Lima. Fewer candidates were able to explain that the higher rainfall in Bogota could be due to relief rainfall because of the elevation of Bogota or explain that temperature is lower at higher altitudes due to the lower air pressure. Some candidates were able to discuss why Punta Arenas had the lowest average annual temperature, explaining that its location near the pole meant that it was at a low angle to the sun's rays at this higher latitude.

(b) Some candidates met many of the requirements of this question by writing a balanced and carefully considered discussion on the effect of drought on an MEDC, the effect of drought on an LEDC and a comparison of the effects. Answers which needed some development to reach higher levels often made general statements about LEDCs and MEDCs and did not link their answers to drought conditions. Some of the impacts on MEDCs which were discussed included the effects on agriculture and how this may lead to soil erosion and loss of crops. This was often balanced by the idea that food stores exist and could prevent famine for long periods of time and the idea that food supplies could be imported to meet any loss in harvest. Candidates discussed having to use more irrigation methods or maybe grow crops which were more drought resistant. Many candidates contrasted this with the impact on LEDC farmers who may not be able to rely as heavily on irrigation methods and may eventually suffer famine as stores of food are not available. LEDCs may need to use international aid to prevent famine.

Question 5

(a) Very few candidates selected this optional question. Those who did generally described the factors that affected soil formation. To develop answers further these needed to be linked to the type of soil produced. Connections which could be made include the temperature being low at the top of the slope which would lead to slower chemical weathering, meaning rocks are not broken down to soil components very readily and therefore shallow soil. The high wind speed at the top of the hill may lead to very dry soils, or reduce the ability of plants to grow, leading to less organic matter in the soil. The warmer, less harsh conditions in the valley lead to lots of soil fauna activity so soil is well mixed, leading to the formation of brown earth with longer growing seasons resulting in larger amounts of organic matter being added to the soil.

(b) Candidates were confident in discussing a wide range of strategies which would lead to the sustainable management of soil. Many candidates identified a strategy, described how it would work to improve soil condition, then named a location where this strategy is used followed by an evaluation, often mentioning where this strategy would work and where there would be limitations. Candidates who needed to improve their responses often only considered one strategy which limited the breadth of their answer. Many candidates also discussed the challenges caused by the need to feed an increasing population and the pressure that this puts on to soil; a number of named case studies were provided of locations where soil had been mismanaged and could no longer be farmed.

ENVIRONMENTAL MANAGEMENT

Paper 8291/12
Paper 12

Key messages

- In ***Section A***, candidates should take note of questions which ask for reference to data and focus their answers on this.
- In ***Section A***, candidates should be aware of the number of marks available for each question and develop responses that make that many points.
- Appropriate subject specific vocabulary should be used in responses.
- In ***Section B***, detailed case studies and examples are required.

General comments

There was a good response to all questions on the paper with candidates scoring equally well on ***Section A*** and ***Section B***. Candidates generally performed more highly on **Question 1** (atmospheric pollution) compared to **Question 2** (plate tectonics). Topics that were found most challenging were volcanic processes and hazards.

In ***Section B***, there was a fairly even distribution of responses between the three options. Candidates wrote some excellent extended responses in ***Section B***; for the 10-mark part of the question there was excellent application of the data provided and for the 30-mark part candidates provided balanced and well-supported responses.

Comments on specific questions

Section A

Question 1

(a) (i) This question was answered well by the majority of candidates who provided a range of explanations including that coal was a finite resource, that if it was continued to be used at the current rate it would run out before more could be formed, and they identified it as a fossil fuel which would take millions of years to form.

(ii) Many candidates described the trend of coal consumption in detail. Some answers could have been developed by indicating the time period when an increase in consumption occurred and the time when the use was constant.

(iii) Candidates were confident in carrying out the calculation, they were able to total the amount of energy from each source and then work out the percentage of their total which was from renewable sources, 17.7%.

(iv) Candidates demonstrated their understanding of this subject very well in this question, there were many well-developed answers provided. Many candidates suggested three individual reasons and therefore gained all of the credit available. Popular answers included the response to international agreements and protocols, and renewable resources being more accessible due to technological improvements and to meet the increasing demand for energy.

(b) (i) Many candidates showed good understanding of the processes which link atmospheric carbon dioxide concentration and global temperature. Answers often started with identifying carbon

dioxide as a greenhouse gas and went on to state that these gases would absorb long wave/infra-red radiation. Other points included that the infra-red radiation had been re-emitted back from the Earth's surface and that this process prevents the radiation leaving the atmosphere, causing it to warm up.

(ii) Many candidates answered this well and were awarded the credit as they discussed the effect of ice melting in terms of ice having a high albedo effect and also discussed the increase in water in the ocean with its high heat capacity. Others were unclear about the Earth's energy budget and linked it to renewable energy sources.

(iii) This question was answered exceptionally well by many candidates who described in detail a wide range of impacts that flooding would have on a low-lying area. Descriptions were clear and concise and used subject specific vocabulary.

Question 2

(a) (i) This question was answered correctly by virtually all candidates.

(ii) Many candidates described the role of convection currents in the plate movements shown in **Fig. 2.1**; some developed their answer further to mention the heat source being radioactive decay in the core and the idea that hotter material is more buoyant so will rise while colder material is denser and therefore sinks. Some candidates were awarded credit by discussing the processes of ridge push or slab pull as mechanisms for plate movement.

(iii) A range of answers were given for this question. Most candidates were able to identify that **Y** was located on a plate boundary and that **Z** was a mid-plate location. Fewer candidates linked location **Y** as a potential site for melting to occur or included the development that molten rock needed to then reach the surface for volcanic eruptions to occur.

(iv) Many candidates were able to give a confident account of how evidence could be used to support the theory of plate movement, a wide range of evidence was discussed and applied in a scientific way.

(b) (i) Candidates needed to draw various pieces of evidence from the account and apply it to their knowledge of basaltic lava behaviour. The idea that the damage was not immediate allowed many candidates to develop detailed suggestions. Many candidates noted that the lava flow stopped before reaching the town, they knew that basaltic lava was often not explosive and has a low viscosity. Some candidates suggested that as many deaths were caused by famine this effect would not be immediate and may take time for food supplies to be exhausted.

(ii) Candidates made effective use of the information supplied together with their own knowledge of how eruptions can cause international impacts. Many responses discussed how ash and sulfur can be carried across the world by the wind/air currents. They discussed how ash was very light and therefore easy to transport. Many candidates added to their explanation by noting that the volcano erupted for a very long time, so ash was created for a long period of time. Candidates developed their answers further by noting that food supply would be affected beyond Iceland and explained this process.

Section B

Question 3

(a) **Fig. 3.1** showed the predicted path of Hurricane Florence. Candidates used the information to provide detailed descriptions of the path of the hurricane. The predicted change in intensity was identified by many and the direction and approaching speed was also described well with candidates using the gaps between estimated arrival times. Stronger candidates noted the increasing margin of error as time proceeded and explained why this was to be expected. Candidates then linked this information to the benefits of being able to predict the characteristics of an approaching hurricane. Some responses were linked to general hazard preparation while the strongest responses discussed specific measures used in hurricane prone locations.

(b) Candidates structured their responses well for this extended question. Responses often referred to the statement and started by considering the long-term effects of climate change, including

increased risk of extreme temperatures, droughts, ice melting and sea level rise. Candidates often developed these ideas to include case studies of appropriate locations. Good responses then went on to discuss the types of monitoring which may be appropriate, including measuring temperature variation, carbon dioxide concentrations and satellite imagery amongst other suggestions. Stronger responses further discussed that to address long-term climate change there would need to be a significant change in behaviour and to enforce the change evidence from monitoring would be needed. Candidates then discussed some of the actions which would be suitable. Many answers gave a considered and balanced evaluation weighing up the time taken for long-term monitoring and the speed at which action is needed.

Question 4

(a) There were many good responses to this question where candidates effectively described how climate would affect the depth of weathering. Candidates effectively described the patterns, identifying which conditions led to the maximum and minimum depth of weathering. The role that temperature and water plays in the rate of chemical weathering was explained as was the idea that freeze-thaw weathering required the temperature to range from above zero to below zero to allow for the expansion and contraction of water volume. Many candidates added to their descriptions by discussing the role of rock type, features within the rock and the role of acid rain.

(b) Virtually all candidates who attempted this question were able to outline several strategies to manage slopes, including afforestation, slope reduction, drainage, surface protection such as shotcrete or gabions and wire mesh. The strategies were explained well and linked to named examples in many answers. The stronger responses then evaluated the methods and discussed their suitability in different sites.

Question 5

(a) Candidates were able to discuss the environmental pressures caused by a reduction in cultivated land and an increase in domestic waste from 1950 to 2010. Occasionally candidates did not use the key and described the opposite situation, although still with development and explanation. Many of the environmental pressures suggested included the amount of litter being produced, the need for landfill, water pollution and harm to animals getting caught in litter. Discussions on loss of cultivated land often referred to loss of vegetation cover leading to soil erosion whereas it is likely that the cultivated land will change use to be developed as housing or industrial areas. Candidates discussed a wide range of relevant pressures caused by this scenario.

(b) Candidates often began their extended responses by discussing what an area of outstanding natural beauty is and often National Parks were named as examples. The natural threats to these areas were often linked to climate change which could be seen as being both a human and a natural threat. Other ideas discussed included risk of forest fires, flooding which may be seasonal, or risks from earthquakes or volcanoes. Candidates drew on ideas for strategies from across the syllabus considering how natural hazards are managed. In considerations of human threats, the role of climate change was discussed again alongside urban sprawl, demand for materials, forest management and flood management schemes. Some candidates also mentioned the role of governments. Evaluations considered the balance between these threats and which were considered likely to be most severe.

ENVIRONMENTAL MANAGEMENT

Paper 8291/13
Paper 13

Key messages

- In ***Section A***, candidates should take note of questions which ask for reference to data and focus their answers on this.
- In ***Section A***, candidates should be aware of the number of marks available for each question and develop responses that make that many points.
- Appropriate subject specific vocabulary should be used in responses.
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General comments

There was a good response to all questions on the paper with candidates scoring equally well on ***Section A*** and ***Section B***. Candidates generally performed more highly on **Question 1** (atmospheric pollution) compared to **Question 2** (plate tectonics). Topics that were found most challenging were volcanic processes and hazards.

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Comments on specific questions

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(ii) Many candidates described the trend of coal consumption in detail. Some answers could have been developed by indicating the time period when an increase in consumption occurred and the time when the use was constant.

(iii) Candidates were confident in carrying out the calculation, they were able to total the amount of energy from each source and then work out the percentage of their total which was from renewable sources, 17.7%.

(iv) Candidates demonstrated their understanding of this subject very well in this question, there were many well-developed answers provided. Many candidates suggested three individual reasons and therefore gained all of the credit available. Popular answers included the response to international agreements and protocols, and renewable resources being more accessible due to technological improvements and to meet the increasing demand for energy.

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dioxide as a greenhouse gas and went on to state that these gases would absorb long wave/infra-red radiation. Other points included that the infra-red radiation had been re-emitted back from the Earth's surface and that this process prevents the radiation leaving the atmosphere, causing it to warm up.

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(iii) A range of answers were given for this question. Most candidates were able to identify that **Y** was located on a plate boundary and that **Z** was a mid-plate location. Fewer candidates linked location **Y** as a potential site for melting to occur or included the development that molten rock needed to then reach the surface for volcanic eruptions to occur.

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Section B

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(b) Candidates structured their responses well for this extended question. Responses often referred to the statement and started by considering the long-term effects of climate change, including

increased risk of extreme temperatures, droughts, ice melting and sea level rise. Candidates often developed these ideas to include case studies of appropriate locations. Good responses then went on to discuss the types of monitoring which may be appropriate, including measuring temperature variation, carbon dioxide concentrations and satellite imagery amongst other suggestions. Stronger responses further discussed that to address long-term climate change there would need to be a significant change in behaviour and to enforce the change evidence from monitoring would be needed. Candidates then discussed some of the actions which would be suitable. Many answers gave a considered and balanced evaluation weighing up the time taken for long-term monitoring and the speed at which action is needed.

Question 4

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(b) Virtually all candidates who attempted this question were able to outline several strategies to manage slopes, including afforestation, slope reduction, drainage, surface protection such as shotcrete or gabions and wire mesh. The strategies were explained well and linked to named examples in many answers. The stronger responses then evaluated the methods and discussed their suitability in different sites.

Question 5

(a) Candidates were able to discuss the environmental pressures caused by a reduction in cultivated land and an increase in domestic waste from 1950 to 2010. Occasionally candidates did not use the key and described the opposite situation, although still with development and explanation. Many of the environmental pressures suggested included the amount of litter being produced, the need for landfill, water pollution and harm to animals getting caught in litter. Discussions on loss of cultivated land often referred to loss of vegetation cover leading to soil erosion whereas it is likely that the cultivated land will change use to be developed as housing or industrial areas. Candidates discussed a wide range of relevant pressures caused by this scenario.

(b) Candidates often began their extended responses by discussing what an area of outstanding natural beauty is and often National Parks were named as examples. The natural threats to these areas were often linked to climate change which could be seen as being both a human and a natural threat. Other ideas discussed included risk of forest fires, flooding which may be seasonal, or risks from earthquakes or volcanoes. Candidates drew on ideas for strategies from across the syllabus considering how natural hazards are managed. In considerations of human threats, the role of climate change was discussed again alongside urban sprawl, demand for materials, forest management and flood management schemes. Some candidates also mentioned the role of governments. Evaluations considered the balance between these threats and which were considered likely to be most severe.

ENVIRONMENTAL MANAGEMENT

Paper 8291/21
Paper 21

Key messages

- Candidates need to be aware of the equal balance between ***Section A*** and ***Section B*** of the paper and should plan their time and answers accordingly.
- In ***Section A***, candidates should note the number of marks available for each part question and write 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 make sure that they understand the difference in meaning of the command words such as state, suggest, predict, justify, describe, explain, compare and evaluate.
- Candidates should avoid repeating the question in their answers to make best use of examination time.
- Candidates should show all working out in calculation questions as credit may be available for the correct calculation method.

General comments

There was generally a good response to all questions across the paper, although in some cases performance was uneven across the two sections of the paper. Some candidates found **Question 1** (water withdrawal/conservation) less demanding than **Question 2** (photosynthesis and biodiversity). Topics which proved more challenging were the process of desalination, factors affecting the rate of photosynthesis and biodiversity in the tropical rainforest.

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

The strongest 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) Most candidates were able to access some credit. Stronger candidates correctly interpreted the information and used the data effectively to support their answer. Weak answers referred to a general increase in water withdrawal without, or using incorrectly read, data.

(ii) This question was accessed by most candidates, with answers most often referring to population increase and climate change. Where a misunderstanding in **Question 1(a)(i)** had occurred, in which the candidate thought more water was available, corresponding incorrect answers referred to more rainfall, increased sea level, or new technology allowing more access to water sources.

(iii) The majority of candidates correctly described two strategies to manage conservation of water with answers mostly relating to restricting water use in some way and not doing things with running water, e.g. leaving faucets running.

(b) (i) Most candidates were able to access full credit for 'higher population' and 'more industrialised' relating to the USA. Some candidates did not specify whether they were referring to the USA or Egypt.

(ii) This question was less well accessed with candidates unable to explain the processes by which water is desalinated to produce freshwater. Common misconceptions were that salt evaporates and filtering removes salt. Very few candidates were able to name distillation or reverse osmosis.

(iii) Most candidates gained some credit by providing one advantage and one disadvantage with 'an abundant resource' and 'being expensive' as the most common responses. Very few candidates used the key term potable, a few referred to drinking water but the majority just referred to freshwater as in the question stem. Weak answers referred to the process taking a long time.

(c) Successful answers linked global warming to the melting of ice in glaciers or icecaps and reduced freshwater availability in some way. Weaker candidates generally did not mention how the availability of freshwater changed but just stated a rise in sea level. Some candidates suggested this would increase the availability of freshwater. Few answers referred to impacts on other freshwater stores, and lakes, rivers and groundwater were rarely considered. A common error was to describe acid rain or acidification of oceans.

Question 2

(a) (i) **X** was correctly identified as glucose or sugar by most candidates. Incorrect answers often labelled **X** as a plant, nitrogen, soil, chlorophyll or pollination. This question was sometimes missed out in error.

(ii) Most candidates simply rewrote the information provided in the question or described the equation for photosynthesis in a sentence. Candidates could achieve credit by mentioning leaves, chloroplasts, chlorophyll or the idea of sunlight being absorbed. Most of those who gained full credit did so by giving both chloroplasts and chlorophyll in their answers.

(iii) In general, this question was not well answered. Credit was often accessed by linking an increase in carbon dioxide to increased photosynthesis. A common misconception was that an increase in carbon dioxide would be detrimental to the rate of photosynthesis, with the rate slowing or stopping and the plant dying. Very few candidates made reference to (named) limiting factors.

(iv) Most candidates accessed some credit. Some confused abiotic and biotic factors with biotic factors less likely to be correct.

(b) (i) This question was accessible to all candidates with the majority able to use **Fig. 2.2** to describe the distribution of tropical rainforest correctly as near the equator and between the Tropic of Cancer and Tropic of Capricorn.

(ii) This question was more challenging and generally less well answered. Very few candidates accessed full credit. The common misconceptions were that: trees prevent litter falling to the ground, herbivores are eating all the leaves off the ground, wind blows all the leaves away and trees do not shed their leaves because of the climate in the rainforest. Successful answers were characterised by a good understanding of optimum conditions for microbial decomposition and the rapid recycling of nutrients in a nutrient cycle.

(iii) Candidates accessed credit through the idea of there being a favourable climate. In good answers, there was an awareness of stratification of the rainforest providing a variety of habitats and supporting complex food webs. Strong candidates demonstrated knowledge of the stability of the ecosystem and the availability of specialist niches. Weaker candidates just referred to a habitat and lots of food being available rather than more food types and a variety of habitats.

(iv) This question was challenging, and was often limited to answers relating to biodiversity. Habitat destruction was the most common correct answer. To improve, candidates needed to give further examples of food resources, e.g. cocoa being used and impacted by land clearance. Greater understanding of carbon sequestration or impact on local water cycle and microclimate was required. Answers often referred to global impact rather than in an area of tropical rainforest.

Section B

Question 3 and **Question 4** were almost equally popular while **Question 5** was chosen by fewer candidates. Parts **(a)** and **(b)** were equally well answered with only a small number of candidates not completing both parts.

Question 3

(a) Most candidates were able to select the relevant information on causes of flying insect loss and the effect from **Fig. 3.1**. Stronger candidates explained the causes and effects and gave examples of application, e.g. for bees, the effect on pollination of flowers and the impact on food webs and food supply.

(b) This was generally well answered. Successful responses needed to show a good range of strategies to protect endangered species and their habitats, and the principles upon which they were based needed to be explained. The chosen strategies, e.g. Endangered Species Act, National Parks, conservation areas or captive breeding were exemplified with specific endangered species being conserved such as the Loggerhead Turtle, African Elephant, White Rhino and Giant Panda. Stronger candidates provided a balanced argument and included evaluative statements in their answer. Weaker candidates restricted their answers to ways of reducing pesticide and fertiliser use and reducing habitat loss through not draining wetlands as outlined in **Fig. 3.1**.

Question 4

(a) Most candidates made good use of **Fig. 4.1** to identify agricultural, industrial and domestic causes of pollution, although many omitted references to domestic pollution from towns. Good answers were developed with suggested pollutants such as detergents, untreated sewage, fertiliser and industrial effluent from various sources, and explained how the water became polluted through seepage, run-off or direct dumping. Stronger responses referred to the concentration of pollution in some areas, to point and non-point source pollution and run-off leading to nutrient enrichment and eutrophication. Very few candidates mentioned hypoxic zones.

(b) This question assessed knowledge of strategies to manage waste control and the extent to which these can reduce pollution of rivers. Some answers were a continuation of **Question 4(a)** and focused on the causes of pollution, describing pollution rather than strategies. These answers were limited to the Ganges and did not differentiate between local and regional strategies. Weaker responses referred to limiting pollution but did not suggest how the pollution could be limited, for example, by reducing agricultural run-off, stopping oil spills, restricting industrial waste, reducing littering and limiting pesticides. Successful answers included local and national strategies identified through specific examples and in the strongest responses, the relative success of strategies was assessed, e.g. Clean Water Act, waste management infrastructure, re-using grey water for irrigation and how agricultural practices can reduce the run-off from fertilisers through timing, quantity and crop rotation. Some answers discussed waste control in general rather than how to reduce river pollution.

Question 5

(a) Stronger answers made good use of **Fig. 5.1**, covering the full range of water supply, waste, energy and the environment, and offered some balance of advantages and disadvantages.

(b) The most successful answers demonstrated good knowledge of international protocols, the Montreal Protocol and the Paris Agreement being the most common, and offered good balance with evaluation of the successes and limitations of the protocols. Many candidates' answers were very generalised with no reference to international protocols but did contain some relevant information. Some answers focused on the relevant threats from a growing population and described these rather than international protocols. Others focused on green initiatives following on from **Question 5(a)** and some successfully linked these to climate change and solutions, e.g. the need for renewable energy, eliminating fossil fuel use and reducing emissions. Weaker candidates did not include information on the protocols, and therefore answered a population management question rather than the one posed.

ENVIRONMENTAL MANAGEMENT

Paper 8291/22
Paper 22

Key messages

- Candidates need to be aware of the equal balance between ***Section A*** and ***Section B*** of the paper and should plan their time and answers accordingly.
- In ***Section A***, candidates should note the number of marks available for each part question and write 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 make sure that they understand the difference in meaning of the command words such as state, suggest, predict, justify, describe, explain, compare and evaluate.
- Candidates should avoid repeating the question in their answers to make best use of examination time.
- Candidates should show all working out in calculation questions as credit may be available for the correct calculation method.

General comments

There was generally a good response to all questions across the paper, although in some cases performance was uneven across the two sections of the paper. Some candidates found **Question 1** (vegetation cover and food webs) less demanding than **Question 2** (fertiliser use and groundwater stores). Topics which proved more challenging were the effect of light intensity on photosynthesis and pollution of aquifers.

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

The strongest 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) Most candidates were able to access credit with a response stating that **Fig. 1.1** shows that the Dominican Republic has more vegetation cover or trees than Haiti. Few candidates were able to access full credit which required reference to the soil being exposed, small scrub bushes or grassland, or the lack of shelter in Haiti. Common incorrect answers included that Haiti has more mountains or reference to steepness of slopes.

(ii) The majority of candidates correctly suggested two reasons for the differences in vegetation cover. The most common responses were that Haiti has had more deforestation than the Dominican Republic, and that the Dominican Republic has stricter rules or regulations preventing deforestation.

(iii) This question was well accessed with the majority of candidates able to explain the effect of loss of vegetation cover on soil correctly. Successful answers linked the ideas of a lack of roots binding the soil and reduction in the litter layer resulting in the soil being exposed to the forces of erosion and consequent loss of soil fertility.

(iv) This question required candidates to explain the decrease in biodiversity when vegetation cover is lost and proved to be challenging for some. Weaker responses just referred to loss of habitat making animals vulnerable to endangerment or extinction. Stronger candidates linked the loss of vegetation to the loss of shelter, loss of food and reduction in water availability, leading to disruption of the food web and reduction in species variety. Some candidates did not show full understanding of the key term 'biodiversity'.

(b) (i) The majority of candidates were able to correctly plot a scatter graph from the data in **Table 1.1** and accurately draw a line of best fit.

(ii) Most candidates were able to describe the change in the percentage of the area covered by rainforest between 1985 and 2020, with the use of figures, as a decline of 41%. Where figures were not used, candidates did not access the credit unless there was reference to the magnitude of the decline, e.g., steep decline.

(c) (i) There was a mixed response to this question, with some candidates correctly stating the number of trophic levels in **Fig. 1.2** as five. Where candidates gave an incorrect response, the answers ranged widely with the most common response being four.

(ii) Most candidates were able to state the trophic level with the most energy as plants, Level 1 or producers.

(iii) The majority of candidates were able to access full credit by explaining that howler monkeys are both primary and secondary consumers because they eat both plants and insects, e.g., caterpillars and fire ants.

(d) Most candidates accessed credit by linking increased light intensity to increased photosynthesis but, in general, this question was not well answered. Few candidates used the words 'limiting factor' but the idea of a limiting factor was implied in some answers.

Question 2

(a) (i) The process occurring in the water shown in **Fig. 2.1** was correctly identified as eutrophication by most candidates. Incorrect answers often stated that the process was run-off or groundwater pollution.

(ii) This question was generally well answered with the majority of candidates gaining most of the credit. The most successful answers included reference to decomposers using up the oxygen in the process of respiration, leading to the fish suffocating. Weaker responses tended to refer simply to fish dying due to lack of oxygen.

(iii) This question proved challenging for most candidates with very few being able to refer to strategies such as planting of leguminous plants which are nitrogen fixing, use of organic fertilisers which are slower release, subsidies for organic farming, use of reed beds to filter water and growing of GM crops which are adapted to poor soils. Most candidates accessed some credit for reference to legislation and education.

(b) (i) Some candidates were able to state the type of aquifer labelled in **Fig. 2.2** correctly as: **A** unconfined and **B** confined. A few candidates gave the correct terms but stated them the wrong way round.

(ii) This question proved challenging with very few candidates accessing all of the credit available. Some candidates stated other pollutants, e.g., carbon dioxide which affects the atmosphere rather than groundwater stores. Most candidates accessed some credit with the most common responses being chemicals from industrial waste and pesticides.

(iii) Some candidates found this question challenging. Successful answers linked the idea that groundwater moves slowly so recharge takes a long time and those aquifers are difficult to access for remediation. Some candidates did not answer this question.

(iv) Knowledge of strategies to prevent the pollution of groundwater stores was assessed and the most successful answers were detailed with developed points. Most candidates gained medium levels of credit. Weaker candidates' answers were generally vague and showed some confusion between atmospheric pollution and water pollution.

Section B

Question 3 and **Question 4** were almost equally popular while **Question 5** was chosen by fewer candidates. Parts **(a)** and **(b)** were equally well answered with only a small number of candidates not completing both parts.

Question 3

(a) Most candidates were able to describe the advantages and disadvantages of constructing large scale dams such as the Grand Ethiopian Renaissance Dam using **Fig. 3.1**. Stronger candidates were able to offer some balance of advantages and disadvantages in their response. Weaker candidates tended to focus more on the advantages with only one or two disadvantages in comparison.

(b) Successful answers needed to recognise the concept of shared resources, e.g., the water in rivers flows through more than one country, and demonstrate understanding that this can lead to conflict due to difficulty in obtaining international agreement. Stronger candidates provided a balanced argument and included evaluative statements in their answers. Weaker answers were limited to describing sources or areas of conflict with little development and a brief statement of whether they agreed or not with the statement in the question.

Question 4

(a) Most candidates were able to select some relevant information on ecological islands from **Fig. 4.1** to describe the advantages and disadvantages of creating an ecological island to conserve a particular habitat. Stronger responses described the need for a balance between preservation of the habitat whilst allowing access to public and scientific research, and the cost of establishing and maintaining protective measures and patrols.

(b) This question assessed knowledge of conservation methods other than ecological islands. Stronger candidates were able to use a range of examples such as National Parks, conservation areas, game reserves, parks and zoos and ecotourism, and critically assess the relative success of each. Weaker answers generally listed a range of strategies with little development and evaluation.

Question 5

(a) Stronger answers made good use of **Fig. 5.1**, which suggested that as the human population grows the number of people living with severe water stress will increase from 38% to 47%. These responses discussed a range of factors which lead to people living under severe water stress, including the idea that LEDCs have few resources to build appropriate infrastructure or provide water catchment or storage systems.

(b) Many candidates found this question on the difficulty of providing potable water in countries of different levels of economic development challenging, and it was generally not well answered. Weaker responses were superficial and tended to focus on cost in general and the inability of LEDCs to provide potable water. More successful answers should include a range of different systems needed to supply potable water, along with a balanced comparison of LEDCs and MEDCs. Examples should be included, such as the idea that political will is required to solve the issues, and that LEDCs often need to rely on NGOs for support and input.

ENVIRONMENTAL MANAGEMENT

Paper 8291/23
Paper 23

Key messages

- Candidates need to be aware of the equal balance between ***Section A*** and ***Section B*** of the paper and should plan their time and answers accordingly.
- In ***Section A***, candidates should note the number of marks available for each part question and write 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 make sure that they understand the difference in meaning of the command words such as state, suggest, predict, justify, describe, explain, compare and evaluate.
- Candidates should avoid repeating the question in their answers to make best use of examination time.
- Candidates should show all working out in calculation questions as credit may be available for the correct calculation method.

General comments

There was generally a good response to all questions across the paper, although in some cases performance was uneven across the two sections of the paper. Some candidates found **Question 1** (vegetation cover and food webs) less demanding than **Question 2** (fertiliser use and groundwater stores). Topics which proved more challenging were the effect of light intensity on photosynthesis and pollution of aquifers.

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

The strongest 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

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(ii) The majority of candidates correctly suggested two reasons for the differences in vegetation cover. The most common responses were that Haiti has had more deforestation than the Dominican Republic, and that the Dominican Republic has stricter rules or regulations preventing deforestation.

(iii) This question was well accessed with the majority of candidates able to explain the effect of loss of vegetation cover on soil correctly. Successful answers linked the ideas of a lack of roots binding the soil and reduction in the litter layer resulting in the soil being exposed to the forces of erosion and consequent loss of soil fertility.

(iv) This question required candidates to explain the decrease in biodiversity when vegetation cover is lost and proved to be challenging for some. Weaker responses just referred to loss of habitat making animals vulnerable to endangerment or extinction. Stronger candidates linked the loss of vegetation to the loss of shelter, loss of food and reduction in water availability, leading to disruption of the food web and reduction in species variety. Some candidates did not show full understanding of the key term 'biodiversity'.

(b) (i) The majority of candidates were able to correctly plot a scatter graph from the data in **Table 1.1** and accurately draw a line of best fit.

(ii) Most candidates were able to describe the change in the percentage of the area covered by rainforest between 1985 and 2020, with the use of figures, as a decline of 41%. Where figures were not used, candidates did not access the credit unless there was reference to the magnitude of the decline, e.g., steep decline.

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(d) Most candidates accessed credit by linking increased light intensity to increased photosynthesis but, in general, this question was not well answered. Few candidates used the words 'limiting factor' but the idea of a limiting factor was implied in some answers.

Question 2

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(ii) This question was generally well answered with the majority of candidates gaining most of the credit. The most successful answers included reference to decomposers using up the oxygen in the process of respiration, leading to the fish suffocating. Weaker responses tended to refer simply to fish dying due to lack of oxygen.

(iii) This question proved challenging for most candidates with very few being able to refer to strategies such as planting of leguminous plants which are nitrogen fixing, use of organic fertilisers which are slower release, subsidies for organic farming, use of reed beds to filter water and growing of GM crops which are adapted to poor soils. Most candidates accessed some credit for reference to legislation and education.

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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 level of credit achieved varied across almost the full range available; most scripts were in the upper part of the range. Candidates selecting the same or a similar topic evidenced independent data processing and reporting skills, and there appeared no issue of plagiarism, demonstrating that candidates had been given good individual guidance in this respect.

There were a number of candidate reports that achieved very high levels of credit; these demonstrated an excellent approach to the organisation and structuring of projects, whilst at the same time providing strong evidence of collected and collated primary data, often combining this with secondary data sources. Generally, where full credit was not achieved, this was due to not showing use of an appropriate 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 executed methodology.

A significant number of the higher-achieving candidates clearly demonstrated the ability to balance and combine secondary data in support of their primary data when discussing and forming conclusions to their study. These very rigorous reports provided clear evidence of well-planned investigations.

High-achieving candidates most often submitted detailed sources of references in support of their environmental proposals as well as a detailed and considered methodology in their outline proposal form, prior to undertaking the investigation.

Other issues were as follows:

- There was commonly some centre leniency, particularly in assessment criteria C2(a) and (e) and C3(a) and (b); additional credit was awarded where the work did not show the required level of skill.
- Credit was, in some cases, given for criteria not actually present in project reports, e.g. no credit can be awarded for use of a statistical tool when one has not been used, nor can full credit be given for conclusions that do not relate to the candidate's specific data.
- Where projects tended to rely on secondary data only, some reports were overly long and extended beyond the syllabus word count. Candidates need to take care to provide a clear and concise report that aligns with criteria C2(c) and C2(d).

There were many project reports showing an excellent approach towards organisation and structuring of the coursework in a logical order: introduction, methods (justified), results and analysis, conclusions and evaluation. However, a few candidates submitted work that was essentially an extended essay on a particular topic. Candidates and centres need to be able to recognise the difference between a research report and an extended essay, given the range of the assessment criteria. The use of section or chapter headings as well as a contents page were often evidenced in the reports of higher-achieving candidates.

Candidates should carefully consider each of the following:

- Will my hypothesis or question yield viable results?

- Are my 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 in 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?

For administrative purposes, it is important that centres check and ensure the correct mark from the Coursework Assessment Summary Form has been entered correctly on the MS1 form for each candidate. This should be a mark out of 40. Note also that when awarding marks, the use of half marks is not permitted. This may be relevant particularly where a second marker in a centre has reviewed the candidates' work and an average has been taken between the centre's first and second marker, culminating in a total that contains a half mark. This is not allowed.

Candidate Record Cards must be included with the sample of work sent for moderation purposes to help assess consistency of application of the marking criteria.

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 and not implicit to the introduction. This is important as a significant number of candidates concluded that their hypothesis was correct, yet there was no evidence anywhere in the script of a research question or hypothesis. High-achieving candidates most often included 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, C1(c); without this element, there is a risk that the report will become an extended essay, thereby hindering the achievement of C2 criteria.

Where candidates produced reports that had a limited methodology, which was often a brief list without any explanation or justification, it can be difficult to judge whether their methodology would be effective in testing their hypothesis or answering their question. Candidates should not rely on the assumptions of an assessor in this aspect, C1(c).

Skill C2

To achieve full credit for C2(a), candidates needed to make sure all graphs and tables were clearly presented, including 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. Where candidates are using secondary data in the form of graphs, it is very important for them to reference these correctly to avoid any issue of plagiarism; in addition, if the project solely relies on secondary data, it is very important that candidates process that data using their own skills. Copying and pasting a graph from a source without any attempt at processing data will result in C2(a) not accessing full credit.

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

The use of a statistical tool was a weakness for some. 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. A simple mean is unlikely to yield appropriate analysis, unless it is backed up with graphical representation and/or further processing. For full credit, arithmetical averages must be reflected in the candidate's conclusions or discussions. While some candidates demonstrated excellent use of a t-test or standard deviation, there were some instances of credit being awarded when there was no evidence of a statistical tool being used.

The majority of candidates deserved full credit for the general organisation of their work and the quality of written communication, C2(c) and (d).

Skill C3

This skill frequently formed the weakest part of a candidate's work. The main weakness in C3(a), the conclusion, was a lack of reference to the data presented in the report. C3(b) was also often very limited, as only a small number of candidates referred to related environmental management principles, without which full credit cannot be awarded. This element also needs reference to the actual data within the report.

The evaluation needs to be a brief summary of those things that went well and not so well, i.e. success and limitations. There was confusion between an evaluation and a conclusion. Some candidates appeared to evaluate their secondary data, instead of appraising their methodology (success and limitations of the methodology, C3(c)). A relatively small number did not include an evaluation for criterion C3(c).

Concluding comments

The evidence with regard to candidate report submissions demonstrated 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. The selection of topics was excellent and continued to focus on some very key and current environmental issues at a local level, such as the issue of plastic waste, wild fires, or issues of water pollution in relation to excessive fertiliser application to name a few.

Candidates require very close guidance in respect of their project title, as a significant number of candidates tried to review global data (often in relation to climate change), which is an extremely challenging topic given the assessment criteria and word count. In addition, a significant number of candidates based their project on climate change and the frequency of hurricanes; whilst the topic is valid, the sheer scope of study is too large to comply with the word count in addition to the associated level of drawing of conclusions required in a relatively short time span. Careful consideration must be undertaken in order that the title is not too broad in scope, which can often limit 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, C1(c), in it being able to securely test <u>all</u> hypotheses. Close guidance is needed at the project proposal stage.

In addition to the topic chosen, there is the opportunity to learn some research techniques and put them into practice. The stronger topics and final reports were derived from locally based research and the utilisation of primary data often being supported with secondary data.

Appendix 1 is concerned with how centres select their sample for external moderation. Most importantly, it is not necessary for centres with over ten candidates to send the work of 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 candidate's 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. The sample must be sent using a method that provides a tracking facility (i.e. a reputable courier), to arrive by the deadline specified. 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 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. Therefore, all sample reports should be with Cambridge Assessment no later than 14th May.

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