ENVIRONMENTAL MANAGEMENT

Paper 8291/11

Paper 1 Principles of Environmental Management

Key messages

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.

In **Section B**, candidates should indicate clearly which question they are answering, i.e. **Question 6** or **Question 7**. Although it was usually possible to work out which question was being answered, it is good practice to clearly state which question is being answered.

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.

General comments

There was generally a good response to all questions across the paper. Most candidates found **Question 2** (dry and wet acid deposition) and **Question 5** (food webs) more demanding than the other questions in **Section A**.

Topics which proved more challenging were formation of and strategies to reduce formation of acid deposition, definitions of artesian wells and boreholes, strategies to manage water security, food webs and trophic levels, and the carbon cycle.

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

The most successful 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

This question covered the environmental and economic impacts of a hydroelectric dam, and conservation of the Tapanuli orangutan.

(a) Most candidates were able to describe at least two environmental impacts of a hydroelectric dam, with the commonest reference to habitat loss. Generally, there was a lack of distinction between short-term and long-term effects. More successful responses provided one short-term and one long-term impact which were developed.

(b) This question was generally less well answered with a common response of the dam being costly to build rather than the economic impacts of the dam itself. There was often a lack of distinction between the economic impacts on the local and national population, with a common misconception

that a hydroelectric dam provides water security rather than being an energy source. Stronger responses discussed the availability of more jobs at a local level and provision of a renewable energy source at a national level.

(c) Most candidates were able to access credit by describing a conservation intervention rather than just explaining the role of the EDGE programme in conservation.

(d) Most candidates were able to access credit and a very few accessed full credit. The most common two strategies were to provide a protected area to allow breeding and to reduce illegal logging. Weaker candidates tended to list two strategies rather than develop their answer, limiting the credit they could achieve. Successful responses for these strategies explained that captive breeding and release increases the number of orangutans, and reducing illegal logging preserves their habitat.

Question 2

This question covered the topic of the formation of dry and wet acid deposition.

(a) Some candidates were able to correctly state one emission source that can lead to acid deposition with the most common response being emissions from cars. A significant number of candidates incorrectly stated one of the gases or acids from **Fig. 2.1**.

(b) Most candidates were able to describe how wet acid deposition formed with reference to the formation of named acids in the atmosphere which then fall as wet precipitation such as rain.

(c) This question was challenging, not well answered and often limited to descriptions of acid deposition affecting the soil. Very few candidates accessed full credit and it was clear that there was a lack of knowledge of the effect of acid deposition on plant leaves and growth. More successful candidates who accessed some credit were able to comment on the reduction of plant growth.

(d) This question was challenging with responses often vague. Some candidates were able to access one mark for reference to the reduction of fossil fuels or reducing emissions from cars. Overall, applied knowledge on reduction of the formation of acid deposition was lacking. The few successful responses suggested catalytic converters and factory scrubbers as two management strategies.

Question 3

This question covered the topic of food insecurity.

(a) (i) This question was not well answered. Where candidates showed their working, some were able to access credit for stating the total population correctly as 7632.8 million. Very few candidates correctly calculated the percentage of the world's population who are undernourished from **Fig. 3.1** as 10.8%. There were a significant number of candidates who did not answer this question.

(ii) This question was generally well answered with most candidates able to access some credit for reference to sufficient or enough food.

(iii) Most candidates accessed some of the credit available and a few were able to achieve full credit where they gave a good explanation. The two most common causes of food insecurity discussed were climate change or drought and overpopulation. Weaker candidates tended to just list causes, which were often vague, and needed to go on to explain their answers to gain further credit.

(b) This question was more challenging and generally less well answered. A very few candidates accessed full credit with the most common response referring to education or introduction of new skills. Stronger candidates referred to named agricultural methods such as contour ploughing or improved irrigation systems which would improve crop yield. Weaker candidates generally repeated the information in the stem of the question and were not able to apply knowledge of causes of food insecurity in their response.

Question 4

This question covered the topic of water insecurity and strategies for managing water security.

(a)   This question was not well answered with the majority of candidates unable to match the definitions of borehole and artesian well correctly. The most common correct answer was for matching aquifer with the correct definition.

(b)   Very few candidates were able to state one source of ground water correctly with a significant number of candidates incorrectly stating one of the strategies (aquifer, artesian well or borehole) from **Question 4(a)**.

(c)   Most candidates described how ground water stores become polluted from agricultural practices. A common incorrect response was pollution of ground water stores by people discarding their plastic waste such as drink bottles.

(d)   Most candidates were able to access some of the credit and a very few answers gained full credit. The most common response was reference to pollution of ground water stores affecting water quality or limiting drinking water.

(e)   This question was not well answered with very few candidates able to access full credit. Responses that gained credit here generally named one strategy to manage water security, most commonly rationing, and needed to go on to develop their named strategy to explain how this would manage water security.

Question 5

This question covered the topics of food webs, aerobic respiration and the carbon cycle.

(a)(i)   Some candidates correctly stated that the arrows in the food web in **Fig. 5.1** represented the transfer of energy; a common misconception was that the arrows showed what each organism was eating.

(ii)   Most candidates correctly identified the large fish as secondary consumers with only some stating trophic Level 3.

(iii)   Most candidates correctly identified the trophic level with the least energy available as the orca (killer whale) or tertiary consumer with only some stating trophic Level 5.

(iv)   This question was more challenging and generally less well answered. Very few responses achieved full credit. Many answers did not explain how energy is lost from a food web and instead described how the transfer of energy decreased at each trophic level, often referring to the idea that only 10% of energy is transferred to the next level.

(v)   This question was generally well answered with most candidates able to access credit. Most candidates demonstrated that they had an understanding of the impact on the food web shown in **Fig. 5.1**, and in particular on the phytoplankton and orcas, of a decrease in the squid population.

(b)(i)   The word equation for aerobic respiration was generally well known with the majority of candidates accessing full credit. The most common incorrect response was stating carbon dioxide as a reactant and oxygen as a product, which suggested a confusion with the word equation for photosynthesis.

(ii)   Most candidates were able to correctly identify four to five of the processes given to complete the diagram of the carbon cycle, to access most of the credit available. A common error was not being able to identify the two arrows representing decomposition.

(iii)   This question was more challenging and generally less well answered. Successful answers described the role of carbon dioxide as a greenhouse gas, radiation from the sun changing to longer wave radiation and being reflected back to the Earth increasing the temperature and leading to an increase in severe weather or climate events. A common misconception was that carbon dioxide, a greenhouse gas, destroys the ozone in the atmosphere leading to global warming.

Section B

More than half of the candidates chose to answer **Question 6** (international agreements and whale populations) rather than **Question 7** (strategies to manage energy security)**.**

The questions in *Section B* assess two skill areas: AO2 (Information Handling and Analysis) for which there is a total of 8 marks and AO3 (Investigation Skills and Making Judgements) for which there is a total of 12 marks. The two marks are combined to give a total mark out of the 20 marks available.

In general, the majority of candidates were awarded Level 2 for both AO2 and AO3 with a total mark between 8/20 and 12/20. A small number of candidates were unable to achieve more than Level 1 for AO2 as they did not provide any examples to support their answer, and Level 1 for AO3 as their response was largely descriptive and they did not make any judgements. There were very few candidates who did not answer either question in *Section B*.

Question 6

This question was generally poorly answered as, while a significant number of candidates were aware of whaling from a historical aspect, international agreements surrounding an increase in whale populations were not well understood.

Details of international agreements such as the International Whaling Commission (IWC) and the Convention on International Trade in Endangered Species (CITES) and their effects were not mentioned and only generalised opinions given. There were no examples given of activist groups such as Greenpeace and Friends of the Earth. Candidates did not explain why agreements are difficult to introduce and enforce.

Some candidates were able to demonstrate some understanding of the strategies which protect whale species and, to some limited extent, discuss the success of the strategies. Most candidates achieved Level 2 for AO2. Very few candidates were able to achieve more than Level 2 for AO3 as evaluations tended to be one-sided, stating simply that they agreed or disagreed with the statement.

Question 7

Strategies to manage energy security provided stronger responses overall, with candidates demonstrating some knowledge, such as strategies to reduce consumption and waste. Description of renewable resources was evident and showed good understanding. Most candidates cited examples from their own country and some candidates chose to compare different countries in their response. Most candidates achieved Level 2 for AO2.

Very few candidates were able to achieve more than Level 2 for AO3 as evaluative skills were lacking and responses were generally descriptive.

More successful responses included a definition of energy security and then detailed discussion of a range of strategies including increasing energy efficiency in terms of production methods, strategies to reduce waste of energy such as insulation systems and increasing energy production through investing in renewable resources and development of alternative energy technologies.

ENVIRONMENTAL MANAGEMENT

Paper 8291/12

Paper 1 Principles of Environmental Management

Key messages

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.

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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.

General comments

There was generally a good response to all questions across the paper. Most candidates found **Question 3** (Population and dependency ratio) and **Question 4** (Antarctic) more demanding than the other questions in *Section A*.

Topics which proved more challenging were the role of plants in the water cycle, dependency ratio including the calculation of dependency ratio from given data, and analysing data on Antarctic sea ice cover.

Some answers showed a good understanding of terms and attention to detail with effective use of exemplar material. Other responses needed further development of ideas to gain full credit, particularly on the four-mark questions.

The most successful 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

This question covered the topics of ecological pyramids, invasive species and conservation of grassland biomes.

(a) (i) Most candidates correctly identified the trophic level of the snake in **Fig**. 1.1 as a secondary consumer and some stated trophic level 3. The most common inaccurate response was tertiary.

(ii) Most candidates showed a clear understanding that producers make their own food from the process of photosynthesis and accessed full credit. Weaker candidates answered in terms of the benefit provided by producers to the higher trophic levels, but this did not provide a definition of a producer.

(iii)   Candidates were generally able to access most of the credit available. Most responses described the wide base and narrow top of the pyramid or the decreasing numbers with progress up the trophic levels, and then explained this in terms of energy lost. The more successful candidates then gave reasons such as respiration and hunting for this energy loss to gain full credit. Weaker responses simply described which plants or animals were at which levels and achieved no credit.

(b) (i)   Most candidates could identify invasive species as being non-native and that they cause harm to the ecosystem they become established in.

(ii)   This question was generally well answered with most candidates accessing credit by using the question stem information that fire ants kill native ants. More successful responses went on to explain what this would mean for the other organisms in the food web. Weaker responses were vague and discussed in general terms about 'effects' without specifying them. A common misconception was that the fire ants would become the apex predator.

(c) (i)   Where candidates understood that the question was about a grassland biome, appropriate human activities such as land clearance for farming or urbanisation were given. A significant number of candidates did not access the credit available as they wrote about a forest biome and cutting down trees.

(ii)   This question was generally not well answered. Few candidates accessed full credit. Where candidates understood the question was about a grassland biome, appropriate methods were described such as establishing national parks and banning activities like hunting. Ideas were generally not developed, e.g. employing rangers to oversee the banning of activities such as hunting. A common misconception was that banning deforestation or encouraging afforestation were appropriate methods, but these do not apply to a grassland biome.

Question 2

This question covered the topic of the water cycle including the effects of urbanisation on the water cycle.

(a)   Candidates found this question challenging and it was generally less well answered. Most gained a little of the credit available with a few accessing full credit. Candidates often did not understand that the question was asking them to explain what plants do to impact the water flows within the water cycle. Instead, they gave definitions of evaporation or run-off, or focused on an indirect effect of plants such as their roots holding the soil together to limit erosion, which was not relevant to the question being asked. Few responses referred to the stomata releasing water in transpiration or interception of rain by the leaves.

(b)   Where candidates understood that the question was about the impacts of urbanisation on the water cycle rather than just the amount of water or its condition, they were generally able to access some of the credit available. Successful responses had sequenced points about impermeable surfaces leading to less infiltration, more run-off and consequent floods for example. Weaker responses focused on suggestions about water pollution or extraction, or the idea that there would be more evaporation due to the urban heat island effect, which were not relevant to this question.

Question 3

This question covered the topic of population and dependency ratio, including factors which affect migration rate and strategies to manage a changing population.

(a) (i)   Most candidates were able to correctly calculate the population aged 65+ in Nigeria from the information given in **Fig. 3.1** as 3.26 or 3.3%. Some candidates did not access full credit due to excessive rounding errors from 3.26 to 3%.

(ii)   Given the formula in the stem of the question, almost all candidates were able to access credit for the correct substitution of values from the table. Most candidates correctly calculated the dependency ratio for Germany as 54.3. Some candidates needed to show their working as credit may have been gained even if the final answer was incorrect.

(iii)   This question was not well answered with most candidates accessing very limited credit and a very few achieving full credit. Although the focus of the stem of the question was on the overall dependency ratio, most candidates understood that this question could best be answered by

focussing on the differences in the young and aged dependent groups. More successful responses explained why HICs have a higher life expectancy and lower birth rates. Weaker responses tended to be vague with the points discussed in terms of HICs followed by the reverse argument for LICs.

(b)   Most candidates could state one valid factor such as war or drought, but relatively few could develop the idea to explain how the factor affects human migration rate, such as ensuring the migrants' survival for example.

(c)   Many candidates were able to access full credit by clearly developing two ideas to either manage a growing population, such as building more schools and hospitals, or to reduce birth rates through antinatalist policies such as China's former One Child Policy.

Question 4

This question covered the topics of Antarctic sea ice cover, The Antarctic Treaty and strategies to protect the Antarctic environment.

(a) (i)   Most candidates, where they identified periods of increase or decrease in area of sea ice with correct start and end dates, were able to access all of the credit available. Some candidates gave extensive and precise but irrelevant values for the extent of the sea ice despite the question containing no reference to the use of such figures. Weaker candidates often tried to identify each change with a single year, such as a decrease in 2010, which did not access any credit.

(ii)   This question was more challenging and generally less well answered. Most candidates correctly identified the main reason for the periods of sea ice reduction as global warming. Relatively few were able to explain the causes and effects of the global warming. Some candidates focused erroneously on seasonal variations despite only whole years being shown on the graph in **Fig. 4.1**. A very small number of candidates gave a credible explanation for the period of sea ice expansion; a common misconception was that measures to reduce greenhouse gas emissions could be successful one year but not the next.

(b) (i)   Most candidates could make a basic point about individual countries having different political agendas and achieved some credit, and a few were able to develop this point further. Many simply repeated that it was difficult to achieve agreement.

(ii)   Candidates who understood that this question required specific strategies related to the protection of Antarctica, rather than to threatened biomes in general, were able to access most or all of the credit available. A common misconception was the proposal of reforestation as a strategy as this is not relevant to the Antarctic environment. Relatively few candidates were able to give a range of ideas or to fully develop two ideas to access full credit. Weaker responses were vague or in extreme terms, such as stopping any ships from going near rather than controlling the size of cruise ships and banning the use of heavy fuel oil in case they sink or leak for example.

Question 5

This question covered the topics of non-renewable and renewable energy resources, energy security and causes of energy insecurity.

(a)   Most candidates were able to correctly identify oil and nuclear as non-renewable, and wind and solar as renewable energy resources. Some responses incorrectly identified geothermal as a non-renewable energy resource, and a few put one type of energy resource into more than one category or omitted one or two of the energy resources from the table.

(b)   Candidates who had learnt the definition of energy security accessed full credit. Those who were less secure in their knowledge gave the more simple explanation of the ability to supply energy to everyone.

(c)   Most candidates could state two causes of energy insecurity in simple terms such as fossil fuels running out. More successful candidates were able to develop these points with ideas about higher energy prices resulting from depletion of resources, for example, to access full credit.

Section B

Approximately three quarters of the candidates chose to answer **Question 6** (Reduce, Re-use, Recycle) rather than **Question 7** (Strategies to manage food security).

The questions in *Section B* assessed two skill areas: AO2 (Information Handling and Analysis) for which there is a total of 8 marks and AO3 (Investigation Skills and Making Judgements) for which there is a total of 12 marks. The two marks are combined to give a total mark out of the 20 marks available.

In general, the majority of candidates were awarded Level 2 for both AO2 and AO3 with a total mark between 8/20 and 12/20. A small number of candidates were unable to achieve more than Level 1 for AO2 as they did not provide any examples to support their answer, and Level 1 for AO3 as their response was largely descriptive and they did not make any judgements. There were very few candidates who did not answer either question in *Section B*.

Question 6

This question was generally less well answered than **Question 7**. Where candidates were able to give specific examples of each of the three Rs such as refilling plastic water bottles from a tap rather than buying new ones or that recycling involves how waste plastic, paper or metal can be processed into new products (rather than just using different recycling bins which are just about collecting the waste), and could discuss both the advantages and disadvantages of doing so in both environmental and economic terms, they were able to achieve Level 3 for AO2 and Level 4 for AO3.

Some candidates focused solely on the negative impacts on the environment of using landfills to dispose of waste or other methods of simply disposing of the waste elsewhere. This limited their response to Level 2 for AO2.

Some candidates did not consider a range of methods of waste disposal for comparison. This limited their response to Level 2 for AO3.

Question 7

This question was generally more successfully answered than **Question 6**. Effective responses gave a definition of food security and then described a range of strategies to manage food security such as subsistence agriculture, the increase in food production by intensification and extensification of agriculture and improved agricultural techniques.

Many candidates referred to HICs and LICs in their evaluation, although this was not a requirement of the question.

Stronger candidates provided directly relevant examples of specific locations and gave a balanced evaluation of the strategies to achieve Level 3 for AO2 and Level 4 for AO3. Weaker candidates tended to list a range of strategies with little development, use of specific examples or evaluation, limiting their response to L2 for AO2 and AO3.

ENVIRONMENTAL MANAGEMENT

Paper 8291/13

Paper 1 Principles of Environmental Management

Key messages

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Candidates should avoid repeating the question in their answers to make best use of examination time.

General comments

There was generally a good response to all questions across the paper. Most candidates found **Question 2** (dry and wet acid deposition) and **Question 5** (food webs) more demanding than the other questions in **Section A**.

Topics which proved more challenging were formation of and strategies to reduce formation of acid deposition, definitions of artesian wells and boreholes, strategies to manage water security, food webs and trophic levels, and the carbon cycle.

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

The most successful 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

This question covered the environmental and economic impacts of a hydroelectric dam, and conservation of the Tapanuli orangutan.

(a)   Most candidates were able to describe at least two environmental impacts of a hydroelectric dam, with the commonest reference to habitat loss. Generally, there was a lack of distinction between short-term and long-term effects. More successful responses provided one short-term and one long-term impact which were developed.

(b)   This question was generally less well answered with a common response of the dam being costly to build rather than the economic impacts of the dam itself. There was often a lack of distinction between the economic impacts on the local and national population, with a common misconception

that a hydroelectric dam provides water security rather than being an energy source. Stronger responses discussed the availability of more jobs at a local level and provision of a renewable energy source at a national level.

(c)   Most candidates were able to access credit by describing a conservation intervention rather than just explaining the role of the EDGE programme in conservation.

(d)   Most candidates were able to access credit and a very few accessed full credit. The most common two strategies were to provide a protected area to allow breeding and to reduce illegal logging. Weaker candidates tended to list two strategies rather than develop their answer, limiting the credit they could achieve. Successful responses for these strategies explained that captive breeding and release increases the number of orangutans, and reducing illegal logging preserves their habitat.

Question 2

This question covered the topic of the formation of dry and wet acid deposition.

(a)   Some candidates were able to correctly state one emission source that can lead to acid deposition with the most common response being emissions from cars. A significant number of candidates incorrectly stated one of the gases or acids from **Fig. 2.1**.

(b)   Most candidates were able to describe how wet acid deposition formed with reference to the formation of named acids in the atmosphere which then fall as wet precipitation such as rain.

(c)   This question was challenging, not well answered and often limited to descriptions of acid deposition affecting the soil. Very few candidates accessed full credit and it was clear that there was a lack of knowledge of the effect of acid deposition on plant leaves and growth. More successful candidates who accessed some credit were able to comment on the reduction of plant growth.

(d)   This question was challenging with responses often vague. Some candidates were able to access one mark for reference to the reduction of fossil fuels or reducing emissions from cars. Overall, applied knowledge on reduction of the formation of acid deposition was lacking. The few successful responses suggested catalytic converters and factory scrubbers as two management strategies.

Question 3

This question covered the topic of food insecurity.

(a) (i)   This question was not well answered. Where candidates showed their working, some were able to access credit for stating the total population correctly as 7632.8 million. Very few candidates correctly calculated the percentage of the world's population who are undernourished from **Fig. 3.1** as 10.8%. There were a significant number of candidates who did not answer this question.

(ii)   This question was generally well answered with most candidates able to access some credit for reference to sufficient or enough food.

(iii)   Most candidates accessed some of the credit available and a few were able to achieve full credit where they gave a good explanation. The two most common causes of food insecurity discussed were climate change or drought and overpopulation. Weaker candidates tended to just list causes, which were often vague, and needed to go on to explain their answers to gain further credit.

(b)   This question was more challenging and generally less well answered. A very few candidates accessed full credit with the most common response referring to education or introduction of new skills. Stronger candidates referred to named agricultural methods such as contour ploughing or improved irrigation systems which would improve crop yield. Weaker candidates generally repeated the information in the stem of the question and were not able to apply knowledge of causes of food insecurity in their response.

Question 4

This question covered the topic of water insecurity and strategies for managing water security.

(a)   This question was not well answered with the majority of candidates unable to match the definitions of borehole and artesian well correctly. The most common correct answer was for matching aquifer with the correct definition.

(b)   Very few candidates were able to state one source of ground water correctly with a significant number of candidates incorrectly stating one of the strategies (aquifer, artesian well or borehole) from **Question 4(a)**.

(c)   Most candidates described how ground water stores become polluted from agricultural practices. A common incorrect response was pollution of ground water stores by people discarding their plastic waste such as drink bottles.

(d)   Most candidates were able to access some of the credit and a very few answers gained full credit. The most common response was reference to pollution of ground water stores affecting water quality or limiting drinking water.

(e)   This question was not well answered with very few candidates able to access full credit. Responses that gained credit here generally named one strategy to manage water security, most commonly rationing, and needed to go on to develop their named strategy to explain how this would manage water security.

Question 5

This question covered the topics of food webs, aerobic respiration and the carbon cycle.

(a) (i)   Some candidates correctly stated that the arrows in the food web in **Fig. 5.1** represented the transfer of energy; a common misconception was that the arrows showed what each organism was eating.

(ii)   Most candidates correctly identified the large fish as secondary consumers with only some stating trophic Level 3.

(iii)   Most candidates correctly identified the trophic level with the least energy available as the orca (killer whale) or tertiary consumer with only some stating trophic Level 5.

(iv)   This question was more challenging and generally less well answered. Very few responses achieved full credit. Many answers did not explain how energy is lost from a food web and instead described how the transfer of energy decreased at each trophic level, often referring to the idea that only 10% of energy is transferred to the next level.

(v)   This question was generally well answered with most candidates able to access credit. Most candidates demonstrated that they had an understanding of the impact on the food web shown in **Fig. 5.1**, and in particular on the phytoplankton and orcas, of a decrease in the squid population.

(b) (i)   The word equation for aerobic respiration was generally well known with the majority of candidates accessing full credit. The most common incorrect response was stating carbon dioxide as a reactant and oxygen as a product, which suggested a confusion with the word equation for photosynthesis.

(ii)   Most candidates were able to correctly identify four to five of the processes given to complete the diagram of the carbon cycle, to access most of the credit available. A common error was not being able to identify the two arrows representing decomposition.

(iii)   This question was more challenging and generally less well answered. Successful answers described the role of carbon dioxide as a greenhouse gas, radiation from the sun changing to longer wave radiation and being reflected back to the Earth increasing the temperature and leading to an increase in severe weather or climate events. A common misconception was that carbon dioxide, a greenhouse gas, destroys the ozone in the atmosphere leading to global warming.

Section B

More than half of the candidates chose to answer **Question 6** (international agreements and whale populations) rather than **Question 7** (strategies to manage energy security)**.**

The questions in *Section B* assess two skill areas: AO2 (Information Handling and Analysis) for which there is a total of 8 marks and AO3 (Investigation Skills and Making Judgements) for which there is a total of 12 marks. The two marks are combined to give a total mark out of the 20 marks available.

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Question 6

This question was generally poorly answered as, while a significant number of candidates were aware of whaling from a historical aspect, international agreements surrounding an increase in whale populations were not well understood.

Details of international agreements such as the International Whaling Commission (IWC) and the Convention on International Trade in Endangered Species (CITES) and their effects were not mentioned and only generalised opinions given. There were no examples given of activist groups such as Greenpeace and Friends of the Earth. Candidates did not explain why agreements are difficult to introduce and enforce.

Some candidates were able to demonstrate some understanding of the strategies which protect whale species and, to some limited extent, discuss the success of the strategies. Most candidates achieved Level 2 for AO2. Very few candidates were able to achieve more than Level 2 for AO3 as evaluations tended to be one-sided, stating simply that they agreed or disagreed with the statement.

Question 7

Strategies to manage energy security provided stronger responses overall, with candidates demonstrating some knowledge, such as strategies to reduce consumption and waste. Description of renewable resources was evident and showed good understanding. Most candidates cited examples from their own country and some candidates chose to compare different countries in their response. Most candidates achieved Level 2 for AO2.

Very few candidates were able to achieve more than Level 2 for AO3 as evaluative skills were lacking and responses were generally descriptive.

More successful responses included a definition of energy security and then detailed discussion of a range of strategies including increasing energy efficiency in terms of production methods, strategies to reduce waste of energy such as insulation systems and increasing energy production through investing in renewable resources and development of alternative energy technologies.

ENVIRONMENTAL MANAGEMENT

Paper 8291/21
Paper 2 Management in Context

Key messages

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 between 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 even if the final answer is incorrect.

General comments

Most candidates found some parts of **Question 1** (population density and population pyramids) and parts of **Question 4** (Antarctica and data handling) more demanding than the other questions on the paper.

Topics which proved more challenging were comparing population pyramids, solar radiation management (SRM), the capture-mark-recapture method to estimate population, and mathematical models.

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

The most successful responses included effective use of appropriate examples to illustrate key points, along with supporting details using appropriate terminology.

Comments on specific questions

Question 1

This question covered the topics of population density, population pyramids, effects of climate change and solar radiation management (SRM).

(a) (i) The majority of candidates were able to correctly calculate the population density for Singapore in 2020 as 8108 people km^{-2}.

(ii) Most candidates accessed some of the credit available for this question. The challenges most commonly identified were overcrowding, not enough food and not enough water. Some candidates misread the question and gave benefits rather than challenges.

(b) (i) Candidates found this question more challenging, with many giving responses on the shape of the population pyramid or references to causes, rather than comparing population structure of males and females. Those who answered this question well gave detailed comparative responses rather than just quoting data unqualified.

(ii) Candidates also found this question challenging. While most were able to describe population pyramids, they had limited knowledge on the differences between HIC and LIC population pyramids and were therefore unable to describe or justify the differences between them.

(c) This question was not well answered with the majority of candidates unable to access credit. Application of knowledge was limited in terms of the effects of climate change on Singapore. Very few candidates used the information given in the stem of the question and in **Fig. 1.1**, which shows that Singapore is surrounded by water, and were therefore unable to make the link with flooding impacts. Weaker responses described causes of climate change with a high number of answers referring to increased vehicle emissions caused by a high population and leading to global warming, which was not relevant to this question.

(d)(i) Candidates showed very little knowledge and understanding of strategies such as solar radiation management (SRM) to manage climate change. A common misconception was that spraying sulfate aerosol particles into the stratosphere either protected the ozone layer or removed harmful gases or pollution from the atmosphere.

(ii) Most candidates referred to the fact that the combustion of fossil fuels produces carbon dioxide, a greenhouse gas. Very few went on to discuss SRM technology and its limitations for full credit.

Question 2

This question covered the topics of reduction in forest cover, forest fragmentation, carbon storage linked to type of tree and managed forests.

(a)(i) This question was answered well with candidates suggesting a wide range of reasons for the reduction in forest cover shown in **Fig. 2.1**. Some candidates limited their answer by suggesting that the forest area reduced due to deforestation rather than why the deforestation had occurred.

(ii) Most candidates were able to access some credit, commonly referring to habitat loss and migration of animals as reasons why forest fragmentation can lead to loss of biodiversity.

(b) The majority of candidates were able to explain that trees absorb carbon dioxide from the atmosphere by the process of photosynthesis. Stronger responses provided more detail, referring to chlorophyll in leaves and the capture of light energy, with or without the word or symbol equation for photosynthesis.

(c)(i) A very few candidates were able to calculate the percentage increase in quantity of carbon stored from 2020 to 2050 for conifer trees to achieve the answer of 2400% using **Fig. 2.2**. Some candidates were able to read the correct values of −1000 and 23 000 from the graph to access some credit.

(ii) Most candidates were able to correctly recommend that conifer trees should be planted in the managed forest as they store more carbon.

(d)(i) Graph drawing skills were generally good and most candidates were able to plot the data in **Table 2.1** as a bar chart to access credit. Common errors were drawing bars that were touching and not of equal width.

(ii) This question was not well answered with a significant number of candidates incorrectly referring to more trees being planted by some countries to increase oxygen levels. Successful responses referred to some countries having more land or to mitigate climate change.

Question 3

This question covered the topics of fossil fuels and energy insecurity, and methods to estimate population size of the Mount Augustus Snail.

(a)(i) Most candidates were able to correctly state that oil or natural gas is a non-renewable energy resource, other than coal.

(ii) Candidates found this question more challenging and very few accessed credit. There were many examples of candidates not understanding fossil fuel depletion and the link with energy insecurity,

with inaccurate responses defining fossil fuels and referring to people not being able to use their cars.

(iii) The majority of candidates were able to correctly outline one advantage of rationing fossil fuels, with the most common response that the fossil fuels will last longer. A few candidates were able to give a disadvantage of rationing fossil fuels.

(b)(i) Candidates did not have a good understanding of a capture-mark-recapture method to estimate the population of snails using a pitfall trap. A few candidates accessed a little of the credit available. There were a significant number who did not attempt to answer this question. More successful responses included reference to where the sampling would take place, counting the snails that had fallen into the pitfall trap, marking their shells, releasing the snails back to the same location and repeating the process after at least 24 hours.

(ii) Candidates who knew what the term assumption meant, were able to answer accurately, referring to marking of the snails, i.e. that the marks are not lost, do not harm the snail or do not affect chances of recapture and/or the snails are active. Few candidates referred to the random mixing of the population. Some responses did not gain credit as they only mentioned information already given within the stem of the question.

(c)(i) Most candidates were able to calculate the estimated population size, *N*, for July 2011, using the given formula for the Lincoln Index, to achieve the answer of 4077 and complete **Table 3.1**.

(ii) Most answers included a suitable conclusion about the population of snails, with the majority of successful responses concluding that there was a general decrease in the snail population.

(iii) The majority of candidates were able calculate the number of snails alive after 18 months correctly as 35 from the information given in the question stem.

(iv) Most candidates were able to access full credit for suggesting why 2000 snails were not released back into the wild, with the most common response to allow the snails to breed so they do not become extinct.

(d)(i) Most responses identified the primary consumer in the given food chain correctly as the earthworm.

(ii) Most candidates were able to suggest a disadvantage of using poison to control rats. The most common response was that it may poison other animals that eat the rat.

(e)(i) Most candidates were able to complete **Table 3.2** by calculating the change in mass in grams for snail 3 correctly as –2. A few candidates needed to add the minus sign to indicate a loss in mass for further credit.

(ii) Most candidates were able to correctly calculate the average change in mass for diet **B** as 6.6 or 7 g.

(iii) The majority of candidates accessed the credit available by suggesting that the result for snail 5, diet **A** was due to the snail having a disease or illness. No responses suggested that it could be an anomalous result.

(iv) Most candidates were able to conclude that diet **B** was better because the snails gained more mass than the snails on diet **A**.

Question 4

This question covered the topic of the variation in minimum daily ozone over Antarctica over a 40-year period including ozone depletion, and data from Antarctic ice cores including use of mathematical models to make predictions.

(a)(i) Most candidates, where they identified periods of increase or decrease in the minimum daily ozone with correct start and end dates, were able to access full credit. Some gave extensive and precise but irrelevant values for the minimum daily ozone in Dobson units rather than describing the trend. Weaker candidates often tried to identify each change with a single year, such as a decrease in 1982, which did not access credit.

(ii) Candidates found this question more challenging and few were able to provide reasons for the trend shown by the data in **Fig. 4.1**. There was no mention of CFC use, ozone destruction, the CFC ban or phasing out, or that ozone takes a long time to recover. No candidates suggested that fluctuation is part of a normal cycle. A common misconception was that increased carbon dioxide or greenhouse gases are the main reason for a decrease in ozone.

(iii) Most candidates were able to use the data in **Fig. 4.1** to correctly state the number of years where an ozone hole existed over Antarctica as 11.

(iv) This question was generally well answered, with most candidates giving one and many giving two impacts of ozone depletion on human health, most commonly skin cancer and cataracts.

(b) (i) Most candidates accessed full credit for describing the trend for the concentration of carbon dioxide correctly as a steady concentration until 1800 followed by a rapid or exponential increase after 1800.

(ii) This question was more challenging and poorly answered with very few candidates accessing credit. Candidates did not understand the limitations of mathematical models in predicting future atmospheric carbon dioxide concentrations. Responses were generally vague and it was clear that candidates misunderstood the question being asked. There were a significant number of candidates who did not attempt to answer the question.

(iii) Most candidates were able to successfully complete **Fig. 4.3** to suggest the shape of the graph for the concentration of methane from 1600 to 2000 by drawing a line the same shape as the carbon dioxide line drawn in **Fig. 4.2**.

Question 5

This question covered the topic of open defecation including the use of the EcoSan toilet.

(a) Candidates found this question challenging. Those who understood the question were able to make the link between stopping open defecation and preventing contamination of drinking water and associated diseases such as cholera, loss of earnings through lost time at work and reduction in need for medical care for example, and reduction in poverty. The majority of candidates did not access any credit and a significant number did not provide a response.

(b) (i) Most candidates gained credit by making reference to saving water for other uses.

(ii) Most candidates were able to suggest that drying the waste reduced its mass making it easier to transport and some referred to using the dried waste as a source of energy by burning it.

(iii) Most candidates were able to suggest lack of cleanliness or having to remove the solid waste by hand. Few candidates accessed full credit as applying knowledge to give reasons why people would be unwilling to use the EcoSan toilet was not well understood.

(iv) Most candidates were able to suggest compost or fertiliser as a use for the dried solid waste from the EcoSan toilet.

ENVIRONMENTAL MANAGEMENT

Paper 8291/22
Paper 2 Management in Context

Key messages

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. Teachers can help candidates by making 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. Most candidates found some parts of **Question 3** (investigating biodiversity) and parts of **Question 4** (open defecation, comparing Tiger Worm Toilet and pit toilet) more demanding than the other questions on the paper.

Topics which proved more difficult for candidates were the challenges of low population density, climate of cold desert biome, pioneer species, and sampling techniques.

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

The most successful answers included effective use of appropriate examples to illustrate key points, along with supporting details using appropriate terminology.

Comments on specific questions

Question 1

This question covered the topics of population density, age dependency ratio, population pyramids and a cold desert biome in Mongolia (including primary succession, climate change and water insecurity).

(a) (i)   Most candidates correctly calculated the population density for Mongolia in 2020 as 2 or 2.03 people km^{-2}.

(ii)   Common responses included lack of people to fill the available jobs and a generally lower GDP. Some candidates could have improved by making three separate points or, where they suggested a challenge, developing the idea, e.g. low marriage rates which lead to a low birth rate or population decline.

(b)   Candidates performed well in this question, with accurate descriptions given of the trend in age dependency ratio in **Fig. 1.2** and relevant data used effectively.

(c)   Candidates found this question more challenging as they had to refer to the age dependency ratio for 1975 in **Fig. 1.2** and then think about what the shape of the population pyramid would look like

compared to the shape of the population pyramid shown in **Fig. 1.3**. Candidates were generally unable to describe the shape correctly but most responses achieved credit by reasoning that the birth rate would be higher.

(d)   Responses to this question were generalised in terms of a desert climate such as hot during the day and cold at night, rather than describing the climate of a cold desert biome in both winter and summer. Few candidates were able to provide temperature ranges or commented on the length of the two seasons.

(e) (i)   Candidates needed to suggest how colonisation of the desert area occurred with reference to seeds being carried by wind or animals, for example. Common errors showed a misunderstanding of the question as they included definitions of pioneer species, conditions required for primary succession and descriptions of primary succession.

(ii)   Candidates found this question more challenging with few able to suggest the characteristics of the pioneer species in **Fig. 1.4** such as lichen - withstands harsh environments, grows quickly, or describe adaptations to conserve water.

(iii)   Successful candidates referred to the addition of organic matter or nutrients to the soil through decomposition and a reduction in competition. Weaker responses were often vague and lacked any relevant detail.

(f) (i)   Most candidates were able to correctly calculate the percentage of land area covered by water in Mongolia as 0.68%.

(ii)   Candidates generally answered this question well with many suggesting that climate change alters rainfall patterns and global warming leads to droughts causing water sources to dry up.

(iii)   This question was very well answered with many candidates able to give four clear, distinctive impacts of water insecurity to access full credit.

(g) (i)   Candidates generally answered this question well with many stating that space reflectors reflect solar radiation back to space and therefore reduce global warming.

(ii)   Many candidates were able to suggest that we could continue to use fossil fuels or made reference to the difficulties in reducing combustion of fossil fuels to access the available credit.

Question 2

This question covered the topic of forests, clearance of forested land, global loss of tropical tree cover (including afforestation) and wild fires.

(a) (i)   This question was answered well with responses suggesting a range of reasons for land clearance in **Fig. 2.1**. Some candidates limited their answer by suggesting that the land was cleared due to deforestation rather than why the deforestation had occurred.

(ii)   The majority of candidates gained some credit by explaining the impacts of introducing non-native plant species in terms of invasive species which outcompete the native plant species, and disruption of food chains or food webs.

(b) (i)   Candidates generally were able to suggest that the data in **Fig. 2.2** indicated decreasing tropical forest or increased tropical forest destruction. Some candidates were confused with the graphical interpretation of **Fig. 2.2** as the *y*-axis was loss in tropical tree cover / million ha and the trend in the bars was read incorrectly.

(ii)   Where candidates understood the graphical representation of **Fig. 2.2**, they were generally able to calculate the percentage change in the global loss in tropical tree cover from 2017 to 2018 correctly as between 24 and 25% (depending on whether their value read from the bar for 2017 was 15.8 or 15.9 million).

(iii)   Candidates who were successful in **Question 2(b)(ii)** generally answered this question well, with most suggesting planting more trees or restrictions on deforestation as the reasons for the

percentage change. Those who did not access credit for **Question 2(b)(ii)** were mostly limited in their response, but some were able to give a correct answer to gain the credit.

(c) There were some very good answers to this question, linking the benefits of afforestation to carbon capture, the water cycle and an increase in biodiversity. Weaker candidates needed to develop their answers further rather than just stating a list of benefits.

(d)(i) Graph drawing skills were generally good and most candidates were able to plot the data in **Table 2.2** as a bar chart to access most of the credit available. Common errors were bars drawn touching and of unequal width.

(ii) The majority of candidates were able to calculate the average number of wild fires from 2013 to 2019 in an area of the Amazon rainforest correctly as 8043. Some candidates needed to give their answer to the nearest whole number as instructed for further credit.

(iii) Most candidates were able to correctly describe the distribution of actively burning wild fires in **Fig. 2.3** either in relation to the tropic of Capricorn and tropic of Cancer or in relation to continents and named countries.

(iv) This question was generally answered well with most candidates accessing the majority of the credit available. Responses commonly referred to high temperatures and drought and the link with climate change. More successful responses considered increased lightning strikes and controlled fires getting out of control.

Question 3

This question covered the topics of investigating biodiversity using a kick sampling method and using Simpson's index of biodiversity to analyse data.

(a) This question was poorly attempted and it was evident that many candidates did not have a good understanding of a kick sampling method. The small number of candidates who answered this question well gave detailed responses which included reference to identification of a location to sample, the use of a net with the opening facing upstream, kicking the bed of the stream in front of the net, counting the organisms collected in the net and repeating the process at the same and/or different locations. The majority of candidates either accessed minimal credit for referring to the use of a net or gained no credit. There were a significant number of candidates who did not attempt to answer this question.

(b)(i) Most candidates successfully substituted the values into the given formula and arrived at the correct answer of 0.54.

(ii) The majority of candidates successfully substituted the values into the given formula to achieve the answer of 0.014. Some candidates did not access full credit as they did not give their answer to two significant figures as instructed.

(iii) Many candidates were able to interpret the Simpson's diversity index values in **Table 3.2** and reason that the data shows there is more diversity in the stream in 2020 than in 2019. More successful responses commented that the organisms in the stream in 2020 might be better suited to a lower pH so this does not support the biologist's concern.

(iv) The most common response of 'fertilisers' was given by most candidates; more successful responses suggested acid deposition or acid rain in addition.

Question 4

This question covered the topics of open defecation, questionnaires and sampling strategies and the Tiger Worm Toilet (including a comparison with the pit toilet).

(a) This question was poorly answered with many candidates unable to apply their knowledge of open defecation to the context of urbanisation. The more successful responses referred to urbanisation resulting in an increased population density and linked the increased risk of disease with contaminated water from contact with faeces. The majority of candidates either referred only to the increased spread of disease or gained no credit.

(b) (i) A very few candidates were able to identify the type of feeding relationship as decomposer.

(ii) Most candidates were able to access credit with the most common response of 'not enough water to flush'. More successful responses suggested that the area may be prone to drought in addition.

(iii) Almost all candidates were able to suggest that the use of chemical cleaning products would kill the tiger worms.

(c) (i) The majority of candidates were able to access credit with the most common response of 'random sampling' and more successful responses described the use of a random number generator or the idea of 'drawing names out of a hat'.

(ii) Candidates generally answered this question well. The most common benefit given was 'less time-consuming' and the most common limitation given was 'they could not give an opinion'.

(iii) Candidates found this question more challenging and many suggested an open ended question rather than a closed or yes/no question.

(d) This question was generally well answered with most candidates able to make suitable comparisons between the pit toilet and the Tiger Worm Toilet to gain full credit.

ENVIRONMENTAL MANAGEMENT

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Paper 8291/23
Paper 2 Management in Context

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Key messages

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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 even if the final answer is incorrect.

General comments

Most candidates found some parts of **Question 1** (population density and population pyramids) and parts of **Question 4** (Antarctica and data handling) more demanding than the other questions on the paper.

Topics which proved more challenging were comparing population pyramids, solar radiation management (SRM), the capture-mark-recapture method to estimate population, and mathematical models.

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

The most successful responses included effective use of appropriate examples to illustrate key points, along with supporting details using appropriate terminology.

Comments on specific questions

Question 1

This question covered the topics of population density, population pyramids, effects of climate change and solar radiation management (SRM).

(a) (i) The majority of candidates were able to correctly calculate the population density for Singapore in 2020 as 8108 people km^{-2}.

(ii) Most candidates accessed some of the credit available for this question. The challenges most commonly identified were overcrowding, not enough food and not enough water. Some candidates misread the question and gave benefits rather than challenges.

(b) (i) Candidates found this question more challenging, with many giving responses on the shape of the population pyramid or references to causes, rather than comparing population structure of males and females. Those who answered this question well gave detailed comparative responses rather than just quoting data unqualified.

(ii) Candidates also found this question challenging. While most were able to describe population pyramids, they had limited knowledge on the differences between HIC and LIC population pyramids and were therefore unable to describe or justify the differences between them.

(c) This question was not well answered with the majority of candidates unable to access credit. Application of knowledge was limited in terms of the effects of climate change on Singapore. Very few candidates used the information given in the stem of the question and in **Fig. 1.1**, which shows that Singapore is surrounded by water, and were therefore unable to make the link with flooding impacts. Weaker responses described causes of climate change with a high number of answers referring to increased vehicle emissions caused by a high population and leading to global warming, which was not relevant to this question.

(d)(i) Candidates showed very little knowledge and understanding of strategies such as solar radiation management (SRM) to manage climate change. A common misconception was that spraying sulfate aerosol particles into the stratosphere either protected the ozone layer or removed harmful gases or pollution from the atmosphere.

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Question 2

This question covered the topics of reduction in forest cover, forest fragmentation, carbon storage linked to type of tree and managed forests.

(a)(i) This question was answered well with candidates suggesting a wide range of reasons for the reduction in forest cover shown in **Fig. 2.1**. Some candidates limited their answer by suggesting that the forest area reduced due to deforestation rather than why the deforestation had occurred.

(ii) Most candidates were able to access some credit, commonly referring to habitat loss and migration of animals as reasons why forest fragmentation can lead to loss of biodiversity.

(b) The majority of candidates were able to explain that trees absorb carbon dioxide from the atmosphere by the process of photosynthesis. Stronger responses provided more detail, referring to chlorophyll in leaves and the capture of light energy, with or without the word or symbol equation for photosynthesis.

(c)(i) A very few candidates were able to calculate the percentage increase in quantity of carbon stored from 2020 to 2050 for conifer trees to achieve the answer of 2400% using **Fig. 2.2**. Some candidates were able to read the correct values of −1000 and 23 000 from the graph to access some credit.

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with inaccurate responses defining fossil fuels and referring to people not being able to use their cars.

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(ii) Candidates found this question more challenging and few were able to provide reasons for the trend shown by the data in **Fig. 4.1**. There was no mention of CFC use, ozone destruction, the CFC ban or phasing out, or that ozone takes a long time to recover. No candidates suggested that fluctuation is part of a normal cycle. A common misconception was that increased carbon dioxide or greenhouse gases are the main reason for a decrease in ozone.

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