ENVIRONMENTAL MANAGEMENT

Paper 8291/11
Paper 11

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 their answers accordingly. This will give them an indication of the amount of content and detail expected.

It is important that instructions are followed carefully. Candidates should be reminded of the differences in meaning of command words such as state, suggest, explain, describe and discuss.

Candidates should avoid repeating the question in their answer to avoid wasting exam time. When asked to show working it is advisable to do so as credit may be available for correct calculations.

General comments

There was a reasonably good response to all questions on this paper, and performance was relatively even across the two sections of the paper. Topics which were most challenging were the explanation of evaporation and convection and how these relate to incoming solar energy and the Earth's energy budget, and the structures used to create earthquake resistant buildings.

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

(a) (i) Weaker responses simply rephrased "incoming solar radiation" but stronger answers referenced energy.

(ii) This was generally well answered. A significant number of candidates gained credit for their working.

(iii) This question was usually answered correctly.

(iv) Weaker responses were more concerned with providing analogies for budget rather than dealing with the science. It was very rare to see balance/equilibrium referenced.

(v) The two terms were not clearly understood and many responses were weak. Evaporation was the better understood of the two processes. Weaker responses simply referred to energy coming in and going out (rising up). Stronger answers referred to solar energy heating the water causing the

change of state to gaseous vapour for evaporation, and referred to surface heating exchanging energy with the air and the resultant lighter hot air rising.

(vi) This was generally well answered with a good understanding of the role of cloud cover and the likely effects of a volcanic eruption. Weaker responses usually referred to lava flows rather than the ash clouds.

(b) (i) Weaker candidates referred to both graphs in this question rather than the first graph. Fluctuations and the overall rise were the most common answers, though some candidates made use of the data.

(ii) This was generally well answered with the strongest answers linking the two graphs then accurately describing the processes leading to global warming. Weaker responses described ozone depletion instead.

Question 2

(a) (i) The type of plate boundary was well understood.

(ii) The movement of the plate was described well.

(iii) Some candidates described events which were for subduction or constructive earthquakes. Successful answers included the position on the boundary and how the two plates sliding past each other led to an earthquake event.

(iv) Few candidates spotted the linear nature of the pattern. Stronger answers described the pattern of dates and distances and referred to the plate boundary.

(v) Candidates had less understanding of the pressure build-up and sudden release to the west each time due to the movement of the respective plates.

(b) (i) This was well answered in general with candidates able to pick relevant details from the text and explain them using valid science. Key facts used were the magnitude, proximity, tsunami, fire and infrastructure.

(ii) Only the strongest candidates answered this question well, with weaker candidates giving generalised descriptions such as “strong” or “resistant” without clear explanations. Some weaker answers included slope management strategies and referred to tree planting as an earthquake resistant strategy for the building. Some drawings without text were accepted where the drawing clearly showed the correct addition. Stronger answers referred to the springs, shock absorbers and flexible materials whilst also referencing how they would absorb the effects by, for example, absorbing the shock waves.

Question 3

(a) Stronger responses for this question linked the events and provided some implications, but rarely in sufficient detail. There were many weaker answers where candidates just copied the labels from the figure with little supporting explanation.

(b) Local level strategies were very well understood and there was good use of examples, but these were often not developed or evaluated in weaker responses. Global strategies were less well understood. Stronger answers referred to international protocols in detail, and evaluated the effects of both strategies.

Question 4

(a) The concept and structure of the graph was understood by candidates. However, weaker responses just reproduced the data with little analysis or explanation. The most successful answers described the likely policy shift and the effects on different sectors and means of production.

(b) Strong answers put forward both positive and negative views about fossil fuels before making a decision supported by valid descriptions of alternatives.

Question 5

(a) Only the strongest candidates answered this question well. Some candidates attempted to provide reasons for the distribution but many found this challenging. Weaker answers tended to list countries with similar death totals but with little development or explanation.

(b) Some answers struggled to suggest solutions and tended to just describe the problem. Stronger candidates provided a balanced input with strategies to achieve this evaluated as well as coming to a conclusion.

ENVIRONMENTAL MANAGEMENT

Paper 8291/12
Paper 12

Key messages

Candidates need to be aware of the equal balance between ***Section A*** and ***Section B*** of the paper and plan their time and answers accordingly.
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It is important that instructions are followed carefully. Teachers can help candidates by making sure they are clear about the differences in meaning of command words such as state, suggest, explain, describe and discuss.
Candidates should avoid repeating the question in their answer to avoid wasting exam time.

General comments

There was a reasonably good response to all questions on this paper though in some cases performance was uneven across the two sections of the paper. Some candidates found **Question 1** (soils and slope management) less demanding than **Question 2** (weather). Topics which were most challenging were the characteristics of different pressure systems and how these relate to climate, and the causes of seasonal differences in weather.

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

In this session, the more 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

The questions were generally well answered with candidates able to demonstrate a good understanding of soils and slope management.

(a) (i) This was generally well answered with soil movement types being recognised.

(ii) Solifluction was recognised by the majority of candidates.

(iii) Some weaker answers described mass movements with water added as a contribution regardless of accuracy. More successful answers referred to the reduction of friction, lubrication and the addition of mass.

(b) (i) Some weaker answers referred to water despite the question specifically excluding water. Earthquakes were a poplar incorrect answer as well. Stronger candidates gave two valid alternative factors such as mass of buildings and lack of vegetation.

(ii) There was a mixed response to this question with candidates suggesting reasons related to scenery, tourism and agriculture. Successful candidates showed understanding of the effects of poverty, land shortage and over-population.

(iii) This was a well-answered question with candidates demonstrating a good understanding of the different methods of slope management and how each method worked to achieve stability.

Question 2

Candidates in general found these questions more challenging and some showed a lack of understanding about the topic

(a) (i) Some candidates showed confusion about the name of the city and the dot on the map and needed to read the key more carefully. These candidates made errors as a result of misreading the pressure map.

(ii) This topic was not well understood with only the strongest candidates providing clockwise and some description of circulation.

(iii) Many candidates did not appear to understand the circumstances which lead to seasonal variations in climate with many answers referring to weather and the causes of different weather conditions. Those that referred to orbit of the Earth often meant rotation rather than rotation around the sun. Stronger answers mentioned tilt and the resultant differences in insolation.

(iv) Weaker answers confused the effects of the two pressure areas meaning that the high pressure was providing cool wet and windy weather. Few answers referred to differences in wind direction.

(b) (i) This was generally well answered with candidates making good use of the data and interpreting the graphs well.

(ii) The reasons for climate differences between the two cities was less well understood but stronger answers referred to insolation, latitude and ocean currents as factors.

Section B

Question 3

(a) Candidates provided reasonable answers and were able to extract valid data from the figure. Weaker answers tended to simply state information about different fuel usage for each of the seven countries. More successful answers compared the potential availability of resources for some countries with the economic development and likely energy policy.

(b) Well balanced answers gave both positive and negative aspects of fossil fuels and their use and offered alternative strategies for the future. Weaker answers provided a one-sided viewpoint and relied on details of pollution and unnecessary descriptions of global warming.

Question 4

(a) Less successful answers tended to refer to the effects in a global way rather than directly related to the local situation shown in the diagram. Stronger answers dissected the diagram and discussed likely scenarios for each part of the diagram.

(b) Weaker answers tended to have a problem with the global aspect of the question and often interpreted global to mean “in other countries” rather than international protocols. Stronger answers included developed examples of strategies at local and global level and evaluated the relative merits and successes of them.

Question 5

(a) Weaker answers simply listed the features shown in the diagram and suggested how each one might fail in the event of a tsunami. More complex answers reviewed the practical issues and suggested solutions.

(b) This was challenging for many candidates with weaker answers limited to tsunamis and earthquakes (usually ones which cause tsunamis). Better answers recognised that there is a range of hazards and discussed volcanos etc. and made the links between urbanisation and the consequentially larger population at risk.

ENVIRONMENTAL MANAGEMENT

Paper 8291/13
Paper 12

Key messages

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ENVIRONMENTAL MANAGEMENT

Paper 8291/21
Paper 21

Key messages

In ***Section A***, when considering source material candidates should analyse and use specific information to support statements made in answers.

Data should be manipulated not simply quoted from graphs and bar charts.

Key terms should be defined precisely.

In ***Section B***, candidates should use examples from specific locations accurately to allow for relevant evaluations of the strategies used in environmental management.

General comments

Overall candidates performed equally well in ***Section A*** and in ***Section B***.

In ***Section A***, candidates performed better in **Question 2** than in **Question 1**. In the more successful answers, there was good use of information extracted from source material.

In ***Section B***, there was some accurate use of subject specific vocabulary. In **Question 3** and **Question 5** there was some effective use of data. The weakest aspects of answers in ***Section B*** were the development of points in discussion, and the evaluation of examples of environmental strategies in specific locations. **Question 3** and **Question 5** were popular choices for the essay.

Comments on specific questions

Section A

Question 1

(a) (i) Although there were many correct answers, some candidates made simple errors in the calculation. Often percentages for litter and soil were added together to give 27, but not subtracted from 100 to equal the percentage for biomass.

(ii) Many candidates struggled to give a precise definition of biomass. Incorrect answers often included elements of non-living components/abiotic components of the ecosystem or the total mass present in the ecosystem or the total amount of nutrients stored in the rainforest.

(iii) Only the stronger candidates gave sufficiently detailed descriptions of interactions between the stores of nutrients. In general there were few details relating to the processes involved in decomposition or of the organisms involved. Humus formation was not mentioned, bacteria or detritivores were rarely mentioned and processes such as growth, assimilation, feeding, death, decay were not seen in descriptions. There were few references to specific nutrients such as nitrate used in plant growth. Most responses showed a lack of understanding and relied on repeating the information given in the basic flow diagram in the figure. Many answers either identified **Fig. 1.1** as a nutrient cycle or simply described the connections between basic components using labels from **Fig. 1.1** without any further elaboration or detail of the interactions. In weak responses, either an incomplete cycle was described or everything in **Fig.1.1** was described without selecting appropriate information. This included processes such as leaching and weathering, and other losses and gains from the cycle. In these cases, candidates did not focus on

the interaction between stores. Occasionally there were incorrect references to plants taking up nutrients to use in photosynthesis rather than plants taking up water to use in photosynthesis. There was also some confusion between energy flow and nutrient recycling.

(iv) This question was usually answered well. Many candidates were fully aware of the influence of precipitation on the stores, flows of nutrients in a tropical rainforest and the contribution of precipitation as both input and output to the cycle. Strong answers elaborated on the importance of water in the transport of nutrients dissolved in solution and in the process of decomposition, explaining when it was too dry or too wet the rate of decomposition was significantly reduced. Weak answers simply stated that nutrients were added to the cycle through precipitation and weathering, and that leaching and run-off remove nutrients without giving any further elaboration of these points.

(v) Candidates found this question challenging. Only the strongest candidates were able to explain how conditions in the rainforest optimise the rate of microbial activity, resulting in the rapid recycling of nutrients or the promotion of high productivity and plant growth. Few candidates discussed any aspect of the time that nutrients were locked in biomass or the conversion times associated with nutrient movement. In many answers the different sizes of the stores was emphasised, which in effect repeated the question without providing an explanation.

(b) (i) Stronger answers to this question described how all activities shown in **Fig 1.2** involved removing biomass, and would therefore impact upon the nutrient cycle by reducing nutrients. These answers emphasised that small scale agriculture, such as slash-and-burn agriculture, could be sustainable as the soil nutrients can be replenished by allowing the vegetation to undergo succession. Specific effects such as trampling and effects of overgrazing resulting in reduced infiltration, increased run-off, erosion and soil degradation were also highlighted. In general, an awareness that all types of human activity involving deforestation would result in loss of biomass and impact upon the nutrient cycle through reduced nutrients was not evident in many answers. Few candidates considered that some activities would be more detrimental than others, and often suggested that since the small scale agriculture had largest percentage this would be most damaging to the nutrient cycle. Many candidates focused on the activities rather than the ways that these activities affected the nutrient cycle. In many answers, each activity in turn was considered with a focus on deforestation, with no specific reference to biomass being removed in logging or nutrients being lost when crops/animals are harvested. Habitat loss was considered in many answers.

(ii) This question was answered successfully by the majority of candidates, with a variety of valid answers. Candidates were familiar with management strategies and ways in which human impact on rainforests could be reduced. Some candidates were familiar with sustainable forestry practices and referred to agroforestry, strip cutting and selective cutting methods. Many strategies related to conservation of the forest ecosystems, protecting the remaining forests from future use by establishing national parks, nature reserves, promoting ecotourism or establishing a buffer zone between protected forest and agricultural land use. Other strategies related to restoring forest ecosystems through afforestation. Other suggestions focused on reducing future use of forests by reducing human activity, through education, decreased levels of meat consumption, using alternative resources and sustainable agriculture using crop rotation. Vague comments such as “decrease human activity”, “decrease area of land used”, and “reduce logging” were common in weaker responses.

Question 2

(a) (i) This generally well-answered, with careful selection of relevant information extracted from the source material relating to the Mekong Delta flooding. In addition to the basic points, stronger responses showed a good understanding of the hydrological cycle, and included information on increased discharge, soil saturation and height of water table. Answers which focused on the agricultural use of the land linked this to an increased likelihood of flooding as a result of there being fewer forested areas. Some answers incorrectly focused on the dam projects.

(ii) This was another question that elicited a variety of good answers. Candidates demonstrated their understanding of global warming, and were able to say how it would impact on the Mekong Delta. Most candidates explained both the effects on the environment and the population. There were many good answers which linked knowledge of global warming, increased temperature, thermal expansion, sea level rise, inundation and the impact of long term flooding of low lying areas, reducing land area available with consequences for the population and agricultural land use.

However, in many cases the answer to **(i)** was given or repeated, but these answers described the usual situation with regard to the monsoon rain, ice and glaciers melting and the flooding of low-lying areas, rather than changes resulting from global warming. In many answers, short-term flooding events with loss of life and damage to property and crops were considered, instead of long-term flooding and the resulting impact on population distribution and agricultural production in the region.

(b) (i) This question was usually answered successfully with many candidates highlighting two benefits of dam building, with stronger candidates developing their answers with further detail. This included commenting on increasing the residence time of water in reservoir water stores and improving the reliability of water supply for agricultural, industrial and domestic use. Many answers focused on flood control, economic benefits and the opportunity for providing HEP to reduce dependency on fossil fuels. In some answers candidates had not read the question carefully enough and gave more than two benefits without development.

(ii) Candidates were also very familiar with the negative impacts of dam construction and most candidates answered this question reasonably well. Answers mainly focused on suggestions relating to environmental implications. The effect on river flow, sediment build-up, ecological disruption, and impact on fish migration, breeding patterns and reduced biodiversity were well illustrated. In well-balanced answers, the impact on the people was discussed with regard to issues such as the displacement of people, conflicts over water ownership and water security issues for populations affected downstream of the dams.

Section B

Question 3

(a) Data in **Fig. 3.1** clearly showed the decreasing number of oil spills. This point was included in the majority of answers except when no description of **Fig. 3.1** was attempted. Candidates usually gave adequate descriptions of the graph showing the change in the number of oil spills, usually supported with data. In stronger answers, some manipulation of data was attempted with an overall difference in the number oil spills calculated, together with decreases for each decade and some idea of the relative differences. A range of relevant reasons were suggested, such as safer transportation of oil, improved technology, new shipping regulations and lower demand. These reasons were developed in most answers. The strongest answers linked reasons to specific decades and the different rates of decrease in each of the decades were explained. Most candidates provided relevant suggestions for the reduction of oil spills but weaker answers did this without supporting data which meant that answers often lacked balance.

(b) There was a good response at a basic level with a major consideration of plastic as a source of marine pollution. Students typically gave sources such as litter, sewage or agricultural run-off and the impact these have on the marine environment, occasionally giving examples of marine environments or referring to specific oceans. The effect of agricultural run-off and fertilisers causing eutrophication was well documented. Most answers contained some management strategies, usually related to a reduction in the use of plastics. Candidates were able to describe how marine pollution is managed by individual countries but few named countries were included as examples in answers. The most effective answers discussed the ocean as a global environment that requires international cooperation. In weaker answers, candidates often included “rubbish/garbage” as a pollutant but they did not provide a range of pollutants. In addition, there was too much focus on the effects pollutants to marine life, at the expense of detail regarding strategies and extent to which pollutants could be managed. The different forms of marine pollution were known and described in great depth.

Question 4

(a) The isolation aspect of the ecological island was effectively described using the two examples in the photographs, but few candidates discussed this in relation to the isolation of populations. The conservation benefits for the island species were outlined in terms of allowing natural processes such as breeding to take place without interference, by excluding human activity and restricting human access.

(b) A range of conservation methods, supported with suitable examples and an attempt to discuss the benefits and pitfalls of human intervention in ecosystems, were seen in good responses to this

question. The Galapagos Islands provided a suitable example to illustrate a range of conservation strategies, with differing degrees of excluding and including human activity in conservation. Many candidates made a comment about the initial statement and usually said whether or not they agreed with it. Candidates then typically just argued for the side they were taking, e.g. giving examples of how human involvement in conservation was beneficial. Overall there seemed to be a lack of balance in many essays. Candidates were very good at identifying the positive aspects of human intervention in conservation but very few were able to balance this with examples of conservation that did not have human intervention, or where human intervention was minimal. Weak responses focused solely on the impact of human activity on ecosystems and argued for excluding human activity without mention of any methods of conservation or specific examples.

Question 5

(a) **Fig. 5.1** showed the change in the total global population together with the percentage annual growth rate from 1900 to 2015, but the description of changes required in the question only related to the changes in growth rate. Candidates need to be reminded about reading a question carefully as a significant proportion discussed the graph line showing global population growth as opposed to the percentage annual growth rate. Reasons for the changes in growth rate were described well in good answers, with reference to factors such as medical advances, improved health care, provision of contraception as well as the impact of war, disease and famine. In the most effective answers, data was used appropriately to support statements giving reasons for the variation in growth rate. In general, reasons were well developed and justified. Candidates used data specifically linked to reasons for particular intervals of growth rate, and many gave balanced answers including both description and explanation. Weaker answers tended to be unbalanced with reasons developed but with limited use of data and analysis.

(b) Many candidates gave a very short and general description of the impact of population change on (often unnamed) resources in an MEDC as opposed to an LEDC. Some details on the population structure and the level of economic and social development in countries were included in a basic comparison. While some candidates provided a good range of countries of varying degrees of economic development, the focus of their responses in terms of resources was very general. Wealth was considered as a resource alongside technology. Very few candidates discussed specific resources such as water, land, or food resources in relation to impacts such as water scarcity, groundwater depletion, overfishing, deforestation, desertification, depletion of non-renewable energy sources and mineral reserves. The link between population change and impact on resources was not clear in these responses. The focus was mostly on whether a country had sufficient financial resources to address any impact, which meant that the level of response was quite general. There was little, if any, reference to sustainability aspect of resource utilisation. In the most effective answers, candidates identified a range of resources and described how these could have an impact in different countries with changes in population either positively through sustainable practices or negatively through environmental degradation.

ENVIRONMENTAL MANAGEMENT

Paper 8291/22
Paper 22

Key messages

In ***Section A***, candidates should carefully select appropriate information from source material and use the information to support explanations made in answers.

In ***Section B***, candidates should use specific examples to illustrate the application of environmental management strategies.

General comments

Overall candidates performed equally well in ***Section A*** and ***Section B***.

In ***Section A*** candidates performed better in **Question 1** than in **Question 2**.There was good use of information extracted from source material in ***Section A***.

In ***Section B*** there was accurate use of subject specific vocabulary and some effective use of appropriate examples. There was effective use of numerical information in **Question 3(a)** and **Question 4(a)**, when data was extracted and manipulated appropriately. **Question 4** was the most popular choice of essay.

Comments on specific questions

Section A

Question 1

(a) (i) This was answered well by most candidates.

(ii) In stronger answers, it was suggested that certain factors resulted in variation of residence times. In these answers, variables were named and candidates explained how the factors could generate a range of results for a particular water store. In weaker answers, no specific factor or water store was mentioned.

(b) (i) In most answers the relevant information about a pollution incident was extracted from **Fig. 1.1** to identify the industrial point source of the river pollution.

(ii) In successful answers, the sequence of events starting from the dam bursting to the waste reaching the river and the resulting water pollution was briefly described. In some answers, part of the pollution event was incomplete and there was no link shown between the point source of the pollution and the river pollution.

(iii) Information from **Fig. 1.1** was selected and used appropriately to suggest the effects of the pollution on the water quality such as changes in colour, toxicity and potability of the water. In good answers, ideas were linked, for example the increased turbidity to reduced light penetration of water and reduced photosynthetic ability of plant life. In some answers, the changes in the water due to the toxic sludge was confused with pollution due to nutrient enrichment and eutrophication was described. Other candidates incorrectly selected information relating to the pollution of the sea instead of the river.

(iv) The distribution of the pollution discharging into the sea from the river was described well, and in stronger answers it was explained effectively in terms of dispersal and dilution.

(v) In stronger answers, relevant information from **Fig. 1.1** relating to the coastal ecosystems was selected and used to support statements, such as the effect on the reproductive ability of the endangered species and the risk of loss of biodiversity. In other answers, risks to different marine ecosystems such as coral reefs were suggested. Some candidates confused information relating to the sea with information on the river environment and repeated an answer given to **(iii)**. There was no requirement to restrict answers to the form of pollution shown in **Fig. 1.2** and candidates could have considered the effect of other forms of industrial pollution on marine environments, such as thermal pollution, oil pollution, and acid rain. The strongest answers focused on the effect of pollution from industrial waste such as the bioaccumulation and bio-magnification of toxic metals in food chains.

(c) This was usually well answered. A range of strategies to manage river pollution which could alleviate water pollution were described.

Question 2

(a) (i) Abiotic and biotic components of ecosystems were often confused. While many candidates carefully identified one of each correctly from **Fig. 2.1**, other answers contained lists of every component in the figure and these answers often listed components in the wrong category.

(ii) This question was well answered. Candidates were able to demonstrate ecological relationships and the interaction between organisms and their environment in order to describe how the biotic and abiotic components of a natural forest ecosystem interact. In stronger answers, the interactions between biotic and abiotic components were emphasised by detailed reference to processes such as photosynthesis. Other candidates referenced the role of bacteria in nitrification releasing nitrates into the soil store and linked this to a wider cycle of nutrients. Weaker answers successfully linked a biotic and abiotic components in a simple relationship e.g. plant roots absorbing water.

(iii) **Fig. 2.1** was used effectively to compare the aspects of the environment before deforestation with the environmental effects of deforestation, and the effect of using the land for agriculture on the environment. In general the environmental effects of deforestation were explained more successfully than the impact of using the land for agriculture. The increase in the rates of increased runoff, soil erosion and leaching as a result of the removal of trees was clearly stated in most answers, but few implications of using land for agriculture were considered. In stronger answers the impact of using the land for agriculture with a resulting loss of biomass, leaf litter and nutrients in nutrient cycling in ecosystems were emphasised.

(b) This question proved challenging for many candidates. Candidates who did not recognise the environmental effects of using deforested land for agriculture were unable to suggest the potential benefits to alleviate problems when an agricultural system is changed to a sustainable form of agriculture using agroforestry. The sustainability aspect, where human activity is in harmony with the environment, was emphasised in stronger answers with ideas relating to maintenance of tree biomass, the replenishment of soil nutrients through recycling in the natural system, the lack of need for artificial inputs of pesticides and fertilisers to maintain the agricultural output. Maintaining habitat and biodiversity were common answers.

(c) This was answered well by the vast majority candidates. The benefits of ecotourism in the sustainable development of ecosystems conservation were effectively communicated, principally in terms of the economic and conservation benefits.

Section B

Question 3

(a) There was good use of information in this question, with data processed from **Fig. 3.1** to compare the area of land irrigated in 1973 with 2013 and to highlight the regions with greatest/least increase. Data was manipulated to reveal further information such as a percentage increase. Data was used most effectively to support statements giving reasons for the regional differences in the percentage of cultivated land irrigated in 2013. Reasons were well developed and justified.

(b) Successful answers were clear on the impact of agricultural use on water resources. There was good use of specific examples to illustrate the high demand for water for agriculture and the impact on the quantity of water available. For example, the impact of the overuse of water from the Aral Sea, or the over-extraction from groundwater/surface water in the Murray–Darling Basin in Australia for irrigation. These answers also focused on the impact of pollution from agriculture on the quality of water and described the process of eutrophication in detail. Management strategies aimed at protecting the natural supplies of fresh water were effectively outlined. The most effective answers linked the strategies to the specific examples giving country, issues and possible solutions.

Question 4

(a) Data was often manipulated well. The strongest answers extrapolated data from the graph in **Fig. 4.1** to accurately state the number of years taken to increase the global population by each billion. The very strongest answers recognised that these time intervals had decreased over time, is now currently stable and went on to suggest that the time interval may begin to increase again as the growth rate of the global population decreases. In good answers, explanation was linked to the specific time intervals when population was increasing at different rates. Less effective answers simply described the increasing global population growth between 1800 and 2015 without commenting on the time taken to increase the population by each additional one billion. These answers gave no indication of the specific trends. Answers were often unsupported by data and the increasing global population was explained generally without specific reference to time intervals.

(b) Effective answers defined optimum population in terms of the balance between utilisation of resources and population size. In these answers, examples were carefully selected to illustrate contrasting scenarios including where overpopulation is addressed through population policies encouraging a decrease in birth rate, and where underpopulation is tackled with policies which aim to increase birth rate or immigration. The manipulation of resources by countries so that utilisation of resources is sustainable, for example through efficiency of agricultural practices, or the use of renewable energy or technological advances, was considered in the strongest essays. These often explained the term *carrying capacity* and assessed the effectiveness of specific policies.

Question 5

(a) Candidates generally described and explained the impact of rising sea levels on low lying land and attempted to make good use of the diagram, but analysis of the diagrams in **Fig. 5.1** was not always effective. The impact of rising sea levels on the island vegetation and agricultural crops in **Fig. 5.1** were mostly described, but effects on freshwater supplies were less well considered. In the strongest answers there was an attempt to explain how the water table would be affected by the sea level rise and salt water intrusion and how this would impact on the nature of the groundwater.

(b) The first part of this question was answered well, particularly with respect to the impact on sea and ice volumes, but the discussion of the effect of global warming on other water stores was weaker. Stronger answers covered the full range of water stores, and assessed the management of water stores in named countries. Examples where water stores had changed were used to illustrate how countries could respond in such situations. Again, the example of the Aral Sea was used to illustrate how the water store had changed and how action has been taken. Examples of drought situations were used to illustrate short-term measures for dealing with changing water stores, and in very good essays long-term measures were also considered. In weaker answers the management of water stores generally, such as the damming of rivers and desalinisation, were discussed often without reference to specific examples.

ENVIRONMENTAL MANAGEMENT

Paper 8291/23
Paper 22

Key messages

In ***Section A***, candidates should carefully select appropriate information from source material and use the information to support explanations made in answers.

In ***Section B***, candidates should use specific examples to illustrate the application of environmental management strategies.

General comments

Overall candidates performed equally well in ***Section A*** and ***Section B***.

In ***Section A*** candidates performed better in **Question 1** than in **Question 2**.There was good use of information extracted from source material in ***Section A***.

In ***Section B*** there was accurate use of subject specific vocabulary and some effective use of appropriate examples. There was effective use of numerical information in **Question 3(a)** and **Question 4(a)**, when data was extracted and manipulated appropriately. **Question 4** was the most popular choice of essay.

Comments on specific questions

Section A

Question 1

(a) (i) This was answered well by most candidates.

(ii) In stronger answers, it was suggested that certain factors resulted in variation of residence times. In these answers, variables were named and candidates explained how the factors could generate a range of results for a particular water store. In weaker answers, no specific factor or water store was mentioned.

(b) (i) In most answers the relevant information about a pollution incident was extracted from **Fig. 1.1** to identify the industrial point source of the river pollution.

(ii) In successful answers, the sequence of events starting from the dam bursting to the waste reaching the river and the resulting water pollution was briefly described. In some answers, part of the pollution event was incomplete and there was no link shown between the point source of the pollution and the river pollution.

(iii) Information from **Fig. 1.1** was selected and used appropriately to suggest the effects of the pollution on the water quality such as changes in colour, toxicity and potability of the water. In good answers, ideas were linked, for example the increased turbidity to reduced light penetration of water and reduced photosynthetic ability of plant life. In some answers, the changes in the water due to the toxic sludge was confused with pollution due to nutrient enrichment and eutrophication was described. Other candidates incorrectly selected information relating to the pollution of the sea instead of the river.

(iv) The distribution of the pollution discharging into the sea from the river was described well, and in stronger answers it was explained effectively in terms of dispersal and dilution.

(v) In stronger answers, relevant information from **Fig. 1.1** relating to the coastal ecosystems was selected and used to support statements, such as the effect on the reproductive ability of the endangered species and the risk of loss of biodiversity. In other answers, risks to different marine ecosystems such as coral reefs were suggested. Some candidates confused information relating to the sea with information on the river environment and repeated an answer given to **(iii)**. There was no requirement to restrict answers to the form of pollution shown in **Fig. 1.2** and candidates could have considered the effect of other forms of industrial pollution on marine environments, such as thermal pollution, oil pollution, and acid rain. The strongest answers focused on the effect of pollution from industrial waste such as the bioaccumulation and bio-magnification of toxic metals in food chains.

(c) This was usually well answered. A range of strategies to manage river pollution which could alleviate water pollution were described.

Question 2

(a) (i) Abiotic and biotic components of ecosystems were often confused. While many candidates carefully identified one of each correctly from **Fig. 2.1**, other answers contained lists of every component in the figure and these answers often listed components in the wrong category.

(ii) This question was well answered. Candidates were able to demonstrate ecological relationships and the interaction between organisms and their environment in order to describe how the biotic and abiotic components of a natural forest ecosystem interact. In stronger answers, the interactions between biotic and abiotic components were emphasised by detailed reference to processes such as photosynthesis. Other candidates referenced the role of bacteria in nitrification releasing nitrates into the soil store and linked this to a wider cycle of nutrients. Weaker answers successfully linked a biotic and abiotic components in a simple relationship e.g. plant roots absorbing water.

(iii) **Fig. 2.1** was used effectively to compare the aspects of the environment before deforestation with the environmental effects of deforestation, and the effect of using the land for agriculture on the environment. In general the environmental effects of deforestation were explained more successfully than the impact of using the land for agriculture. The increase in the rates of increased runoff, soil erosion and leaching as a result of the removal of trees was clearly stated in most answers, but few implications of using land for agriculture were considered. In stronger answers the impact of using the land for agriculture with a resulting loss of biomass, leaf litter and nutrients in nutrient cycling in ecosystems were emphasised.

(b) This question proved challenging for many candidates. Candidates who did not recognise the environmental effects of using deforested land for agriculture were unable to suggest the potential benefits to alleviate problems when an agricultural system is changed to a sustainable form of agriculture using agroforestry. The sustainability aspect, where human activity is in harmony with the environment, was emphasised in stronger answers with ideas relating to maintenance of tree biomass, the replenishment of soil nutrients through recycling in the natural system, the lack of need for artificial inputs of pesticides and fertilisers to maintain the agricultural output. Maintaining habitat and biodiversity were common answers.

(c) This was answered well by the vast majority candidates. The benefits of ecotourism in the sustainable development of ecosystems conservation were effectively communicated, principally in terms of the economic and conservation benefits.

Section B

Question 3

(a) There was good use of information in this question, with data processed from **Fig. 3.1** to compare the area of land irrigated in 1973 with 2013 and to highlight the regions with greatest/least increase. Data was manipulated to reveal further information such as a percentage increase. Data was used most effectively to support statements giving reasons for the regional differences in the percentage of cultivated land irrigated in 2013. Reasons were well developed and justified.

(b) Successful answers were clear on the impact of agricultural use on water resources. There was good use of specific examples to illustrate the high demand for water for agriculture and the impact on the quantity of water available. For example, the impact of the overuse of water from the Aral Sea, or the over-extraction from groundwater/surface water in the Murray–Darling Basin in Australia for irrigation. These answers also focused on the impact of pollution from agriculture on the quality of water and described the process of eutrophication in detail. Management strategies aimed at protecting the natural supplies of fresh water were effectively outlined. The most effective answers linked the strategies to the specific examples giving country, issues and possible solutions.

Question 4

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(b) Effective answers defined optimum population in terms of the balance between utilisation of resources and population size. In these answers, examples were carefully selected to illustrate contrasting scenarios including where overpopulation is addressed through population policies encouraging a decrease in birth rate, and where underpopulation is tackled with policies which aim to increase birth rate or immigration. The manipulation of resources by countries so that utilisation of resources is sustainable, for example through efficiency of agricultural practices, or the use of renewable energy or technological advances, was considered in the strongest essays. These often explained the term *carrying capacity* and assessed the effectiveness of specific policies.

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ENVIRONMENTAL MANAGEMENT

Paper 8291/03
School Based Assessment

General comments

The overall structure of the reports was very good this year. Most candidates structured their reports in the logical order of: introduction, methods (justified), results and analysis, conclusion and evaluation. Many of these stages were used as a section or as a chapter heading thus achieving full credit in assessment criteria C2c. It is extremely important that Centres as well as candidates recognise the difference between a research report and an extended essay, given the range of assessment criteria, and importantly in satisfying assessment criteria C2c.

Stronger reports were well structured and provided evidence of collected and collated primary data, often combining this with secondary data sources. These candidates had usually submitted detailed sources of information in support of their environmental proposals and included a detailed and considered methodology which was planned prior to undertaking the investigation. However, even some of the strongest candidates did not show evidence of using a data analysis statistical tool or did not provide a clear and reflective evaluation of the investigation, i.e. strengths or weaknesses of the study through its methodology.

The strongest reports were based on the collection and collation of primary data obtained from either field investigations or laboratory work. Some of the stronger candidates clearly demonstrated the use of combining secondary data in conjunction with their primary data and produced very concise and rigorous reports within the 2000 word limit.

While it is positive that candidates are allowed a free choice of topic, there appears to be a significant proportion of Centres that allow candidates to state a very general hypothesis which makes it very difficult to test. Further guidance from the Centre in formulating a hypothesis and developing a suitable method to test it would help candidates to produce stronger assignments.

Candidates should be given close guidance in respect of their project title, as a significant number try and review global data which is extremely challenging given the assessment criteria and word count. Often the title was too broad in scope which limits the testing of the hypothesis effectively. It is the Centres' responsibility to provide close guidance at the project proposal stage.

Candidates should be reminded to consider the following questions while working on their assignment.

Will my hypothesis or question actually 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?

Some issues experienced this series in some Centres were as follows:

Some Centres were late dispatching coursework reports. Deadlines are available on our Samples database.
Leniency, particularly in assessment criteria **C2(a)**, **(b)** and **(e)** and **C3(a)** and **(b)**, was found with some Centres awarding full credit when partial credit was more appropriate.
Credit was given for criteria where these aspects were not actually present in project reports e.g. no credit can be given 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 a candidate's specific data.
Some Centres did not transfer marks from the Coursework Summary Form to the MS1 correctly.
Some Centres did not include the summary sheets and/or individual candidate record forms.

Comments on assessment criteria

Skill C1

Most candidates performed well in this skill area. Either as the project title or as part of an introduction, hypotheses or questions were stated by most candidates and frequently, but not always accompanied by a clear explanation of its underpinning principles. The hypothesis should be clearly written and not implicit to the introduction. This is important as a significant number of candidates tried to conclude that their hypothesis was correct, yet there was no clear evidence anywhere in the work of a research question or hypothesis.

Stating and justifying a methodology was generally adequate. Good quality research requires the formulation of a plan detailing research sites, equipment, expected data and how it will be collated and presented. Weaker reports had a methodology which was often a brief list without any explanation or justification. As a consequence it was often difficult to judge whether or not their methodology would be effective in testing their hypothesis or answering their question.

Skill C2

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

A significant number of candidates could have addressed assessment criteria C2a more strongly. Many graphs and tables were poorly presented. Graphs were sometimes inappropriate for the type of data being represented. Line graphs are suited to continuous data and bar graphs for discrete data. Graphs needed to have axes containing labelled units and both lines and bars needed to be easily interpreted.

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

The use of a statistical tool was generally only seen in stronger reports. There is a difference between statistical methods that are used to describe data and statistical tools that are used to analyse data. The former might include bar charts or line graphs whilst the latter would include correlation, chi squared, t test etc. Unfortunately some Centres awarded this mark when there was no evidence of analytical statistics.

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

Skill C3

This important skill frequently formed the weakest part of a report. 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. This element also needed reference to the actual data within the report.

Centres should remind candidates that the evaluation needs to be a brief summary of those things that went well and not so well i.e. success and limitations. There was some 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). Some candidates did not include an evaluation.

Concluding comments

Reports showed 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 focused on some very key and current environmental issues at a local level. Most candidates used this opportunity to learn some research techniques and put them into practice.