**Cambridge International AS Level**

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary Level

**ENVIRONMENTAL MANAGEMENT** **8291/21**

Paper 2 **October/November 2017**

MARK SCHEME

Maximum Mark: 80

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**Published**

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This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

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This document consists of **17** printed pages.

**Cambridge Assessment International Education**

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 1(a)(i) | *Trend:*<br>with increasing urban development / more buildings and less vegetation or soil cover, there is a decreasing evaporation;<br><br>with (*increasing urban development)* there is decreasing infiltration;<br><br>*use of data/information from Fig.1.1to support trend:*<br>there is an overall decrease from, 40 to 30 / 10 arbitrary units of evaporation and 50 to15 arbitrary / 35 units of infiltration;<br><br>further manipulation of data e.g.<br>a non-linear rate of decrease is described / e.g. increasing impervious surfaces by 25% decreases evaporation by 2 units (5%) but increasing impervious surfaces by 100% decreases evaporation by 10 units (25%), 5 · more; | 4 | *Do not accept any references to differences in rainfall in questions 1(a)(i)–(iv).*<br><br><br><br><br><br>*Accept alternative descriptions using data and information.* |
| 1(a)(ii) | 55 – 10 / 10 = 45 / 10 = 4.5;<br>4.5 ·  100 = 450% | 2 | *Award 2 marks for a correct answer without working. 450% = 2 marks*<br>*ecf for incorrect difference from (i).* |
| 1(a)(iii) | impermeable / non-porous surfaces;<br>prevent water from being absorbed / prevent infiltration into the ground;<br>more water will flow overland as run-off;<br><br>there is less resistance to run-off (due to less vegetation / soil) increasing the rate of flow of water overland;<br><br>reference to structure of the impervious surfaces<br>e.g. gullies which collect and channel the flow of water across the surface of the land to drains; | 2 | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 1(a)(iv) | run-off contains pollutants which contaminate the river environment;<br><br>*e.g.*<br>oil from vehicles collects on the water surface;<br>reducing light penetration;<br>decreasing photosynthesis by aquatic plants;<br><br>nutrients from garden fertilisers, increases the concentration of nutrients in the river water / eutrophication;<br>lowers biodiversity;<br><br>organic matter in sewage increases biochemical oxygen demand;<br>depletion of oxygen in water;<br><br>detergents / chemicals;<br>alter the pH of the water;<br><br>run-off carries sediment / debris;<br>increasing turbidity;<br><br>run-off increases river discharge;<br>increasing the chance of river flooding;<br>damaging / eroding waterside vegetation / river banks; | **4** | *Award 1 mark for a general point on effect of pollution.*<br><br>*Or*<br><br>*For each of 2 effects 2 · 2.*<br>*(1 mark for an explanation of 1 effect and 1 mark for further exemplification.)*<br><br><br>*Pollution must refer to be river pollution. Do not accept pollutants which are not carried in run-off.*<br><br><br>*Do not accept fertiliser alone – must be linked to an urban area.*<br><br><br><br>*Do not accept increased run-off alone as in previous question.* |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 1(b) | *zone 1 / natural forest is linked to the stabilising of river bank by:*<br>tree roots holding soil particles*;*<br>reducing the risk of riverbank erosion;<br><br>*zones 1 and 2 / natural and managed forest is linked to reducing the likelihood of river flooding* through:<br>forest soil absorbing water;<br>reducing river discharge;<br>trapping sediment / soil from agricultural land;<br>reducing sedimentation;<br><br>*zone 2 / managed forest* has fast-growing plants which increase nutrient uptake;<br><br>*zones 1–3 / natural forest, managed forest, grass increase nutrient uptake*:<br>vegetation absorbs excess nutrients;<br>reducing the input of nutrients into the river / reducing the risk of eutrophication;<br><br>*zones 1–3 / natural forest, managed forest, grass slows the rate of run-off* :<br>by providing ground cover;<br>increasing infiltration;<br>improving drainage;<br><br>*zones 1–3 / natural forest, managed forest*, grass *increases biodiversity by*:<br>providing ecological benefits for wildlife;<br>nesting / breeding sites;<br>stratification / variety of habitats / niche;<br><br>*other benefits not listed in Fig. 1.2:*<br>*e.g.* filters groundwater flow from non-point source pollution;<br>acts as a buffer strip; | 8 | *Max 5 if zoning system discussed as a whole and no analysis of zones.* |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 2(a)(i) | e.g.:<br>*1st trophic level:* sea grass / filamentous algae / phytoplankton / photosynthetic algae;<br><br>*2nd trophic level:* green turtle / zooplankton / butterfly fish / coral / reef shark;<br><br>*3rd trophic level:* sea sponge / fan worm / coral / reef shark; | **2** | *2 / 3 trophic levels correct for 2 marks 1correct for 1 mark. Allow algae.* |
| 2(a)(ii) | absorb sunlight energy;<br>produce (organic) food (photosynthesis);<br>nutrients for coral organisms;<br><br>symbiotic relationship; | **2** | *No mark for photosynthesis alone;* |
| 2(a)(iii) | reduced size of coral (colony) / decreased amount of coral;<br>increased predation of coral;<br>more feeding by crown-of thorns starfish; | **2** | |
| 2(a)(iv) | reduced fish stock / declining fish populations;<br><br>reduces food source for higher level consumers / tertiary consumers;<br><br>reduces the number of primary consumers (or named);<br>less consumption of filamentous algae / increasing non-coral algae;<br>increased competition for light / nutrients;<br>decrease in the algae associated with coral;<br><br>less competition for the crown-of-thorns starfish for coral;<br>increasing population of predatory crown-of-thorns starfish;<br><br>destructive fishing methods damaging the coral; | **2** | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 2(b)(i) | *Threats:*<br>A (South East Asia) has greater overall threat with a higher number of threats; *compared to* B (Australia and Papua New Guinea) with fewer threats;<br><br>In A (South East Asia) mainly due to threats from fishing;<br>and more threats in every category of threat (fishing, pollution, coral harvesting, tourism) – use of data from map;<br><br>*compared to in* B in Papua New Guinea with the largest threat from pollution from land, followed by tourism in Australia and (dynamite) fishing in Papua New Guinea;<br>no coral harvesting in B;<br><br>*Impact:*<br>A greater overall impact (reference to data);<br>largest % of coral reefs already destroyed and large % of critical and threatened and lowest % of low impact (8%);<br><br>B has less impact with the largest % in the low risk category (80%);<br>lower % in all other categories of already destroyed, critical and threatened (20%); | 6 | *Answer must be comparative.*<br>*Award a max of 4 for either threats or impacts.* |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 2(b)(ii) | restricting coastal developments which cause sedimentation on the reefs;<br>sediment damages the coral colonies;<br>increased turbidity reduces light for the coral algae;<br><br>reducing land based sources of marine pollution;<br>reducing nutrient input into to the sea by reducing fertilisers from agricultural runoff;<br>reducing sewage from domestic sources;<br>excess nutrients encourage the growth of non-coral algae which outcompete the coral algae;<br><br>reducing marine based pollution by;<br>impose fishing regulations;<br>reducing the exploitation of the coral reef organisms;<br>ban the use of dynamite / cyanide in fishing ;<br><br>control human marine activities;<br>restrict areas of boating / snorkelling to minimise damage to coral;<br>educate the public;<br><br>establish protected areas to preserve species and protect habitats;<br>national park / marine park / conservation area;<br><br>zones for different uses e.g. recreation, shipping ;<br>monitoring the coral: | **6** | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 3(a) | Energy enters the ecosystem as sunlight energy, is transferred by photosynthesis to chemical energy in primary productivity and transferred through the trophic levels from producers to consumers when one organism feeds on another, in food chains. Energy is also transferred to the detritivores and decomposers. At each trophic level energy is lost from the ecosystem as heat in respiration.<br><br>Nutrients are absorbed from the soil by plants, assimilated and passed along the food chains when one organism feeds on another. Dead plants and animals are broken down by detritivores, decomposed by decomposers and the nutrients released into the soil.<br><br>Both energy and nutrients transfer through food chains.<br>Energy flows through the ecosystem while, nutrients are recycled.<br><br>**Please use level descriptors 1** | 10 | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 3(b) | *The question requirements are:*<br>   *to describe the impacts of deforestation on terrestrial ecosystems*<br>   *to describe strategies to reduce the human impact upon ecosystems*<br>   *to assess the strategies*<br>   *to use examples*<br><br>**Indicative content:**<br><br>Deforestation impacts upon the forest ecosystem through loss of habitat and loss of food supply nesting and breeding sites for the community of organisms. Declining populations result in a loss of biodiversity, with species becoming vulnerable, threatened and at risk of extinction.<br><br>Deforestation also impacts the forest environment by affecting climate and the hydrological cycle, for example through reduced evapotranspiration. Soil is impacted through increased surface run-off and the nutrient cycles are affected by increased leaching of soil, soil erosion and soil degradation.<br><br>Strategies to reduce the impact of deforestation include the sustainable use of forest resources for example through selective logging in timber managed areas or agroforestry, by maintaining the forest but using the land for growing a suitable crop.<br><br>Establishing protected forest reserves, preventing the illegal logging of specific species and afforestation of fragmented forest areas can be effective strategies.<br><br>Education by emphasising the benefits of maintaining forest cover and associated wildlife and encouraging ecotourism for the economic value of the forest are alternative strategies.<br><br>**Please use level descriptors 2** | 30 | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 4(a) | There is a decrease in water sourced from outside of the local drainage basin, 19% less in 2010 but there are increases in recycled water, 3% more and groundwater, 16% more. In 2005 piped water from outside of the local drainage basin provided the largest source of water for the city, 10% more than groundwater but in 2010 groundwater provides a larger percentage 25% more than piped water.<br><br>The decrease in the supply of water from sources outside of the local drainage basin may be due to the quantity of water becoming increasingly unreliable or as a result of the reduced availability for a number of reasons. There may have been overuse of the water supply through extraction of water for irrigation use. The river supplying the city may have been dammed for hydro-electric power reducing flow or persistent drought or climate change may have reduced the availability of water. Alternatively the quality of the water may have changed due to contamination by pollutants.<br><br>Due to an increasing urban population with increased demand for water and less water available water from outside of the local drainage basin, a move towards self-sufficiency with the sustainable water use and investment in water treatment has increased the supply of recycled water for the city. Sources of groundwater are used to provide a more reliable and pure source of potable water.<br><br>**Please use level descriptors 1** | 10 | *A description of the changes supported with data from Fig.4.1 and reasons for the changes are required.* |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 4(b) | *The question requirements are:*<br>    *to describe the supply of water from desalination and groundwater in arid countries*<br>    *to consider the advantages and disadvantages of supplying water from desalinisation*<br>    *to consider the advantages and disadvantages of supplying water from groundwater*<br>    *to use examples of arid countries*<br><br>**Indicative content:**<br><br>Advantages of desalination include removing impurities from water to provide potable water. Desalination allows control of a local water supply. Areas which have a poor water supply can improve their own water supply. This reduces the need for pipelines and all the risks involved.<br><br>However there are disadvantages, it is expensive, has high energy demands and can have ecological consequences with an effect on the marine environment and marine organisms.<br><br>The disadvantages of groundwater include the risk of over extraction resulting in depletion of the aquifer or saltwater intrusion. Use of groundwater increases the chances of groundwater pollution including salinisation and polluted groundwater is difficult to treat. It can be expensive to extract water from groundwater particularly if deep wells have to be built.<br><br>Advantages, of groundwater include reliability as it is a renewable source of water provided extraction is not greater than recharge. It may be the only source of freshwater available which is pure and the mineral water is useful for bottled water.<br><br>**Please use level descriptors 2** | 30 | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 5(a) | There is in overall trend of increasing crop production but with variation in the rate of increase over time for example an increase of 250 million tonnes between 1960 and 1970 compared to an increase of 400 million tonnes between 2000 and 2010. There are significant decreases in productivity in some years for example in 1982–1983 and 1986–1988 with a decrease of 1 million tonnes.<br><br>Increasing global population and an increased demand for food requires an increased area of land devoted to agriculture increasing crop production. Mechanisation, the use of fertilisers, higher yielding varieties, and the expansion of irrigation have increased agricultural productivity increasing agricultural production. More recent improvements in productivity are due to technological improvements, for example in genetic modification.<br><br>Variation in agricultural output is due to variation in natural factors affecting primary productivity for example temperature and precipitation. Some years have good harvests while in other years natural factors have caused widespread drought or flooding with devastating effects on harvests.<br><br>**Please use level descriptors 1** | 10 | *A description of the main trends supported with data from Fig. 5.1 and an explanation of the trends is required.*<br>*May refer to climate change.* |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 5(b) | *The question requirements are:*<br>   *to describe the impact of population growth upon the earth's natural resources*<br>   *to consider ways of increasing food resources*<br>   *to assess whether increasing food production is sustainable*<br>   *to use examples of countries at contrasting levels of economic development*<br><br>**Indicative content:**<br><br>Demand for food is expected to continue to grow due to a rising global population. More crops, increased meat production and increasingly more biofuels will be required. This will increase pressure on land resources. Ways of increasing food resources include the use of higher yielding varieties, increasing crop intensity and the further expansion of arable land into areas less suitable for agriculture will require greater use of irrigation and fertilisers. More irrigation will impact on the quantity of freshwater available water and the use of fertilisers will result in more water pollution. More and more of the natural environment will be used for agriculture and destroyed for example; deforestation of the tropical rainforest for agriculture will result in soil degradation. This is unsustainable as a growing population will also require land for housing, industry and agriculture which has already impacted on the environment.<br><br>However the use of biotechnology, genetic engineering and alternative sources of food offer considerable opportunities. Invention may find new ways to increase crop production which is sustainable. Sustainability in food production will take more account of natural resources in an area, involve efficiency of water use and land use balance.<br><br>**Please use level descriptors 2** | 30 | |

**Section A and Section B descriptor levels:**

| Descriptor | Award Mark |
|---|---|
| Consistently meets the level criteria | Mark at top of level |
| Meets the criteria, but with some inconsistency | Middle, mark to just below top mark |
| Meets most of level criteria, but not all convincingly | Just below middle, mark to just above bottom mark |
| On the borderline of this level and the one below | Mark at bottom of level |

| Section A and Section B descriptor levels: |
|---|

**Section B (part a),**

> **Level descriptors 1**

**8–10 marks**
The response:
     contains few errors
     shows a very good understanding of the question
     shows a good use of data or the information provided, where appropriate
     provides a balanced answer

**5–7 marks**
The response:
     may contain some errors
     shows an adequate understanding of the question
     shows some use of data or the information provided, where appropriate
     may lack balance

**1–4 marks**
The response:
     may contains errors
     shows limited understanding of the question
     shows little or no use of data or the information, where appropriate
     lacks balance

| Section A and Section B descriptor levels: |
|---|

**Section B (part b):**

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**Level descriptors 2**
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Responses:

**Level one, 25–30 marks**
    fulfil all the requirements of the question
    contain a very good understanding of the content required
    contain a very good balance of content
    contain substantial critical and supportive evaluations
    make accurate use of relevant vocabulary

**Level two, 19–24 marks**
    fulfil most of the requirements of the question
    contain a good understanding of the content required
    contain a good balance of content
    contain some critical and supportive evaluations
    make good use of relevant vocabulary

**Level three, 13–18 marks**
    fulfil some requirements of the question
    contain some understanding of the content required
    may contain some limited balance of content
    may contain brief evaluations
    make some use of relevant vocabulary

**Level four, 6–12 marks**
    fulfil limited requirements of the question
    contain limited understanding of the content required
    may contain poorly balanced content
    may not contain evaluations
    make limited use of relevant vocabulary

| Section A and Section B descriptor levels: |
| --- |
| **Level five, 1–5 marks**<br>    fulfil a few of the requirements of the question<br>    contain a very limited understanding of the content required<br>    are likely to be unbalanced and undeveloped<br>    evaluative statements are likely to be missing<br>    make no use of relevant vocabulary |