

**MARK SCHEME for the May/June 2006 question paper**

**8291 ENVIRONMENTAL MANAGEMENT**

8291/02

Paper 2

Maximum raw mark 80

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the *Report on the Examination*.

The minimum marks in these components needed for various grades were previously published with these mark schemes, but are now instead included in the Report on the Examination for this session.

- CIE will not enter into discussion or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the May/June 2006 question papers for most IGCSE and GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

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**Section A**  
(Answer all questions in this section)

1 (a) Study Fig. 1.1 which shows the Global Water Cycle. Values show the volume of water (in 1000 km<sup>2</sup>) transported per year.

(i) Explain the difference between the terms *evaporation* and *transpiration*. [2]

Evaporation is the process that involves converting water as a liquid into a gas or water vapour.

Transpiration is the loss of moisture from plants through pores (stomata) on leaves.

(ii) Calculate [2]

1 the total volume of water transported by evaporation and transpiration,

$$= 496 \times 1000 \text{ km}^3$$

2 the total volume of water transported by precipitation.

$$= 496 \times 1000 \text{ km}^3$$

(iii) Name *two* zones within the model in which water is stored. [2]

Two from the following: lake, ocean, atmosphere, ground, and snowfields.

(iv) Describe *two* routes by which water is transferred from the land to the sea. [2]

There are a number of routes:

Precipitation (temporary storage) – rivers – lake – river – sea.

Precipitation and storage – percolation – groundwater flow – rivers directly into the sea.

Surface runoff – rivers – sea.

(v) There is an overall flow of 40 000 km<sup>3</sup> from land to ocean. Explain why the overall flow of water from land to ocean is necessary to keep the global water cycle in balance. [2]

Less water is precipitated on oceans than is evaporated from them/more water is precipitated on land than is evaporated or transpired/there is overall transport of vapour from oceans to land.

(b) Fig. 1.2 shows how the volume of global ice in the form of glaciers and ice sheets has changed over the past 700 000 years. [2]

(i) Describe the pattern of the graph in Fig. 1.2.

volumes of ice have risen and fallen = 1 mark

the pattern is cyclical or periodic = 1 mark

or reference to the time element (long and short periods) = 1 mark

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- (ii) What global climatic conditions would lead to the peaks and troughs shown in Fig. 1.2? [2]

warm and cold periods = 1 mark  
links with troughs and peaks = 1 mark

- (ii) What does Fig. 1.2 suggest will be the next event in the global climate? [1]

An ice age/or cold period.

- (c) Fig. 1.3 shows data derived from an analysis of an ice core. It shows that atmospheric carbon dioxide concentrations are related to average global temperatures.

Describe and explain the relationship shown in Fig. 1.3. [5]

Award marks on the basis of 2 for description and 3 for explanation.

Description. There is a close correlation between peaks and troughs of carbon dioxide and peaks and troughs of temperature = 1 mark  
e.g. 125 000 years ago carbon dioxide = 290 and temperatures +1 = 1 mark

Explanation.

CO<sub>2</sub> is a greenhouse gas = 1

CO<sub>2</sub> is stored in ice sheets and becomes an indicator of past climates = 1

therefore higher recordings of CO<sub>2</sub> indicate warm periods and low amounts cold periods = 1

[20 marks]

- 2 Fig. 2.1 shows the locations of five of the world's major biomes.

- (a) (i) What is the meaning of the term *biome*? [1]

A biome is an area on a global scale that is dominated by a particular type of ecosystem.

A set of ecosystems within a climatic zone.

- (ii) Name *one* biome associated with each of the following climatic conditions [3]

- hot and wet all year  
Tropical Rain Forest
- warm summers, mild winters with rainfall in each month  
Deciduous Forest
- cool short summers, very cold winters, small amount of summer rainfall.  
Tundra

- (b) Table 2.1 contains information on net primary productivity.

- (i) What is the meaning of the term *net primary productivity* (NPP)? [2]

The energy fixed in photosynthesis = 1 mark minus the energy lost by respiration = 1 mark

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**(ii) With reference to Table 2.1 describe how net primary productivity depends upon: [4]**

**1 water availability**

A stronger correlation. Humid areas such as TRF, swamps, estuaries have high npp's = 1 mark; whilst desert, savanna, temperate grasslands (the latter two are marginal areas often irrigated) are low = 1 mark

**2 temperature.**

NPP and temperature show a loose correlation; e.g. TRF, deciduous forest and tundra show an expected gradation = 1, but estuaries and swamps do not fit as easily = 1

**(iii) Describe and explain the characteristics of any two ecosystems listed in Table 2.1. [4]**

The characteristics of the ecosystem (3 features: vegetation, soils, nutrient cycling) = 1 with its link to climate = 1

**(iv) Suggest how changes in net primary productivity could be used as an indicator of climatic change. [3]**

NPP increases result from an increase in temperature = 1 mark  
warming conditions can accompany increases in light intensity = 1 mark  
along with an increase in the rate of photosynthesis = 1 mark and therefore npp = 1 mark

**(c) Fig. 2.2 shows changes in light intensity and carbon dioxide concentration can affect the rate of photosynthesis.**

**Describe how the rate of photosynthesis is related to light intensity and carbon dioxide concentration. [3]**

at low light intensity, an increase leads to a linear/direct/proportionate increase in the rate of photosynthesis (=1 mark)

at high light intensity the rate of photosynthesis is constant and not affected by changes in intensity (= 1 mark)

at low light intensity changes in carbon dioxide concentration do not affect the rate of photosynthesis (= 1 mark)

at high light intensity increasing carbon dioxide concentration increases the rate of photosynthesis (= 1 mark)

There are four points; award three from the four.

**[20 marks]**

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**Section B**  
(Answer one question from this section)

**3 (a) One crisis facing the Earth is that of a global water shortage.**

**Briefly explain why this crisis is being blamed on mismanagement of the following factors: existing water resources, population growth and changing weather patterns. [10]**

Candidates need to combine the three factors to produce a coherent description. Poor water management includes; lack of storage, poor distribution, overuse in urban areas and poor quality. Population growth increases demand beyond the amount supplied in both rural and urban areas. These problems are compounded by climatic change that increases the likelihood of drought.

Award 8 to 10 marks for answers that give a balanced consideration of the three factors and in particular point out how they inter-relate. Answers at this level will refer to the photograph as evidence and give examples.

Award 4 to 7 marks for answers that contain relevance and detail but show a poor balance and do not point out the inter-relationship between the three factors.

Award 1 to 3 marks for answers that are weak in details, do not relate the three factors to each other and do not reveal an understanding of water shortage.

**(b) Using examples, describe and explain why projects aimed at the supply of water for human and economic activity can be both advantageous and damaging. [30]**

Having set the scene in part (a), candidates now have the opportunity to review water supply projects with which they are familiar. There is a need for there to be more than one example and the project should serve both human and economic activity.

Examples of major projects can include: reservoirs, dams etc. Three Gorges, Kainji, Aswan; whilst small scale schemes may involve local irrigation schemes.

Answers should balance:

Description. Where it is, its construction, the factors that needed to be taken into account for its development.

Explanation. Why it has been developed e.g. needs/supply and demand. Who is it for; domestic/industrial or agricultural use.

Advantages should include the criteria used to assess its success which go beyond supplying domestic and economic needs (e.g. reservoirs for recreation, re-establishing ecosystems).

Disadvantages may include effects that are environmental, economic or linked with its construction.

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Band 1 answers should contain more than one example and give a balanced consideration to description, explanation, advantages and disadvantages. There should be a strong element of evaluation as an assessment of advantages and disadvantages is required.

Band 3 answers may only develop one example or in the examples they have chosen contain a poor balance. Answers at this level must be relevant despite their faults.

Band 4. Expect a lack of detail and balance in the answer. At the top of band 4 the example/s may be well chosen but lack development.

**[40 marks]**

**4 (a) Use Fig. 4.1 to describe and explain how a food web functions. [10]**

Answers must refer to Fig. 4.1 and refer to:

- the interactive nature of a food web combining a number of chains  
e.g. vegetation – vole – bald eagle with vegetation – snails – voles – salmon – seal
- trophic levels within the food web  
Producer = Vegetation, Primary consumers = snails or grasshoppers, secondary consumers = herring, predators = bald eagles or killer whales
- the flow of energy through the system from producer to predator; the 90% loss of energy at each stage and why there is loss of energy

Award 8 to 10 marks for a detailed and balanced explanation and description of each part of the answer. Examples from Fig 4.1 should be given.

Award 4 to 7 marks where the answer emphasises one or two of the points and the explanation is weak.

Award 1 to 3 marks for poorly developed answers that make a superficial reference to the food web. Such answers may be confused but contain some relevance to scrape some marks.

**(b) Describe and evaluate the impact of human activity upon *one* named ecosystem with which you are familiar. [30]**

A popular question which should provide candidates with an opportunity for an in depth analysis of an ecological issue. Whilst most may pick up the negative aspect of ecological damage (mining, reservoirs, fires, deforestation, tourism etc.) it should be remembered that conservation measures (national parks, ecotourism) could have positive effects.

Answers should contain a structure that combines:

An identification and location of the ecosystem.

The characteristics of the ecosystem; vegetation, soils, climate with some reference to the fragility of the environment.

The nature of the human activity and its effects upon the ecosystem: negative effects may include: loss of biodiversity and habitat, climatic change, river pollution, desertification and soil erosion, human impacts.

Positive features might include: restoration of the environment, conservation and/or preservation, regeneration of socio-economic infrastructure.

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The evaluation must be linked to the candidate's choice of ecosystem and impact. For negative impacts this should include the degree of exploitation and possibility of recovery whilst positive effects will have a degree of success or failure. It is valid for candidates to combine a negative impact with the positive features of recovery.

Band 1 answers must contain clarity on each of the above points and give them some balance. Overall the answer should display knowledge, understanding and relevant evaluative points.

Band 3 answers may well lack the balance of factors needed to assess either or both negative and positive factors. Although lacking detail some answers could become overemotional and lose sight of the balance needed in the question.

Band 4 answers may contain valid descriptive points but be poor on analysis. Ecological features and the way human activity may disrupt the components of the ecosystem will be poorly developed. Some candidates will list information rather than discuss it.

**[40 marks]**

**5 (a) Study Fig. 5.1. for this question.**

**Describe the changes in levels of pollution in the River Rhine between 1975 and 1995 in each of the following regions. [10]**

**Regions A, B and C**

**Region A South of Basel (Basle) and Freiburg.**

Levels of pollution were relatively low (1-2) with the exception of salt loading (2). By 1995 improvements render much of the southern Rhine effectively pollution free at 1-2 for all categories.

**Region B Basel north to Duisburg.**

1975 Moderately high levels of salt and organic pollutants with high nitrates and ammonium pollution levels. There is a progressive increase in pollution downstream (accumulative). 1995 shows all pollution levels to have reduced to grade 2/3 and nutrients to 3. This is still a downstream increase, although slightly less pronounced.

**Region C from Duisburg to the Rhine Delta**

1975 The most heavily polluted all chemicals having accumulated in a downstream direction; levels 3-4 common for all. In 1995 although nitrate/phosphate pollution remains high (3/4) others have reduced to moderate levels.

The source material contains a lot of information and answers should focus on the changes which have taken place and why. The question is not concerned with how the Rhine became polluted.

For 8 to 10 marks answers should contain a balance between each region. Reference should be made to chemicals and levels of pollution. At the top of the range reference should be made to progressive changes downstream.

4 to 7 marks answers may develop one or two regions in detail and within the range lack detail on levels and chemicals.

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1 to 3 mark answers may well be very general and ignore details on levels/locations and chemicals.

- (b) With reference to examples with which you are familiar, describe and explain the possible impact of sewage disposal and industrial waste upon the health of rivers. Why is river pollution difficult to manage? [30]**

Hopefully section A will provide some clues to how river pollution can be managed. The part of the question is concerned with the impact of river pollution.

The major causes of river pollution include: municipal pollution, mining, storm-sewer runoff, industry and agriculture. The major culprits being: siltation, pathogens, organic enrichment, metals and pesticides.

Agriculture is major source of sediments, pesticides and nutrients particularly nitrogen and phosphorus (fuelled by demand for increased agricultural productivity). The effects this pollution are linked to cancers, drinking water contamination, eutrophication and eventual loss of river biodiversity.

Industrial pollution can include nitrogen, phosphorus, sulphur, petro-chemical waste directly contaminate rivers with consequent effects on river ecology. Mercury contamination is linked to mining and metal processing.

Deforestation can lead to sedimentation and flooding.

Management is difficult because:

The causes are often difficult to find.

The movement of pollutants through the soil is slow.

Supply and demand for agricultural produce places pressures upon farmers.

Rivers are often international and the legislation that applies to one country may not apply to another. The same effects can occur within countries knock-on.

There is a need for coordinated management that occurs in most MEDC's but not in LEDC's.

Band 1 answers must consider the causes, effects and management of river pollution. Answers should outline at least three major causes of pollution and give a clear evaluation of the extent to which they can be managed.

Band 3 answers should outline at least two distinct forms. Whilst the causes may be clearly outlined, effect may receive superficial coverage and the consideration of management superficial.

Band 4 answers might deal with one form of pollution. Expect answers to contain some relevance but be brief and offer generalised explanations and evaluations.

**[40 marks]**



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### Generic Mark Scheme

This aims to provide a scheme for marking 30 mark answers in Section B. The marks are grouped into bands from which it should be possible to locate a mark. The assessment objectives outlined are developed out of the broad objectives for the examination and guideline for locating marks for essays.

**Criterion A.** demonstrates relevant knowledge and understanding applied to a range of issues and problems.

**Criterion B.** communicates clearly in a concise, logical and relevant way.

**Criterion C.** marshal evidence, draw conclusions and make evaluations.

Balance of marks for 30 mark questions;

Criterion A = maximum of 15

Criterion B = maximum of 5

Criterion C = maximum of 10

<b>Band</b>	<b>Level Descriptors</b>	<b>Marks</b>
<b>Band 1</b>	<b>The candidate demonstrates the following abilities where appropriate to:</b>	<b>25-30</b>
<b>A</b>	<ul style="list-style-type: none"> <li>select and use a very good range of accurate and appropriate knowledge;</li> <li>integrate knowledge from a wide range of areas;</li> <li>show a good understanding of the concepts involved;</li> <li>make good use of knowledge derived from personal experience and study;</li> </ul>	
<b>B</b>	<ul style="list-style-type: none"> <li>select and use a form and style of writing appropriate to purpose and complex subject matter with facility;</li> <li>communicate complex ideas clearly and accurately, in a concise, logical and relevant way;</li> </ul>	
<b>C</b>	<ul style="list-style-type: none"> <li>analyse issues and problems well and evaluate them appropriately;</li> <li>develop complex reasoned arguments and draw sound conclusions on the evidence;</li> </ul>	
<b>Band 2</b>	<b>The candidate demonstrates the following abilities where appropriate to:</b>	<b>19-24</b>
<b>A</b>	<ul style="list-style-type: none"> <li>select and use a good range of accurate and appropriate knowledge;</li> <li>integrate knowledge from a wide range of areas;</li> <li>show an understanding of the concepts involved;</li> <li>demonstrate a range of awareness of personally derived and studied knowledge;</li> </ul>	
<b>B</b>	<ul style="list-style-type: none"> <li>select and use a form and style of writing appropriate to purpose and complex subject matter;</li> <li>communicate complex ideas clearly and accurately, in a concise, logical and relevant way;</li> </ul>	
<b>C</b>	<ul style="list-style-type: none"> <li>analyse issues and problems and evaluate them competently;</li> <li>develop complex reasoned arguments and draw conclusions on the evidence;</li> </ul>	

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<b>Band 3</b>	<b>The candidate demonstrates the following abilities where appropriate to:</b>	<b>13-18</b>
<b>A</b>	<ul style="list-style-type: none"> <li>• select and use a limited range of accurate and relevant knowledge;</li> <li>• integrate knowledge from a limited range of areas;</li> <li>• show an adequate understanding of the concepts involved;</li> <li>• demonstrate a limited range of awareness of personally derived and studied knowledge;</li> </ul>	
<b>B</b>	<ul style="list-style-type: none"> <li>• select and use a form and style of writing appropriate to purpose and subject matter;</li> <li>• communicate the ideas clearly and in a logical way</li> </ul>	
<b>C</b>	<ul style="list-style-type: none"> <li>• undertake some analysis of issues and problems and make a superficial evaluation;</li> <li>• develop arguments and draw conclusions;</li> </ul>	

<b>Band 4</b>	<b>The candidate demonstrates the following abilities where appropriate to:</b>	<b>6-12</b>
<b>A</b>	<ul style="list-style-type: none"> <li>• select and use some accurate and relevant knowledge;</li> <li>• integrate knowledge from a very limited range of areas;</li> <li>• show a modest understanding of the concepts involved;</li> </ul>	
<b>B</b>	<ul style="list-style-type: none"> <li>• select and use a limited style of writing, appropriate to purpose and subject matter;</li> <li>• communicate ideas with limited clarity;</li> </ul>	
<b>C</b>	<ul style="list-style-type: none"> <li>• demonstrate limited analysis of issues and problems with limited evaluation;</li> <li>• develop limited arguments and draw limited conclusions;</li> </ul>	
<b>Band 5</b>	<b>The candidate demonstrates the following abilities where appropriate to:</b>	<b>1-5</b>
<b>A</b>	<ul style="list-style-type: none"> <li>• select and use some relevant knowledge;</li> <li>• integrate knowledge from a very limited area;</li> <li>• show a restricted understanding of the concepts involved;</li> </ul>	
<b>B</b>	When producing written communication: <ul style="list-style-type: none"> <li>• select and use a very limited style of writing appropriate to purpose and subject matter</li> <li>• communicate with limited clarity;</li> </ul>	
<b>C</b>	<ul style="list-style-type: none"> <li>• undertake a very limited analysis of issues, problems and evaluation;</li> <li>• recognise some arguments and conclusions</li> </ul>	