UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level

MARK SCHEME for the October/November 2007 question paper

8291 ENVIRONMENTAL MANAGEMENT

8291/02   Paper 2, maximum raw mark 80

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.

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.

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

CIE is publishing the mark schemes for the October/November 2007 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

Section A
(Answer all questions in this section)

1 (a) **Fig. 1.1 shows the under-storey (sub-canopy) vegetation in an area of tropical ra** **forest.**

   (i) **Fig. 1.2 is an incomplete pictorial graph for showing the structure of a tropical rain forest. Add to the graph two additional labelled vegetation layers.**   **[2]**

   One mark for each. Also credit undergrowth and forest floor. Correct diagrams but no labels award one mark.
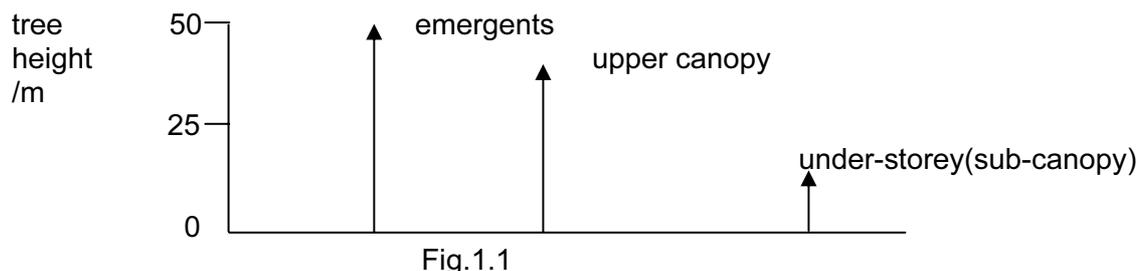
Fig.1.1

   (ii) **Identify *three* different ecosystems that are shown in Fig.1.1.**   **[3]**

   From the photograph the following are observable: river ecosystem, undergrowth, mosses on trees, credit other valid examples.

   (iii) **Describe the biotic and abiotic factors that would sustain *one* of the ecosystems you have identified in (ii).**   **[4]**

   Award 2 marks for biotic and 2 for abiotic.
   e.g. for the undergrowth: biotic includes litter, humus, rapid decomposition; abiotic includes soil, temperatures, moisture.

  (b) **Fig. 1.3 shows the stores and flows of nutrients within a tropical rain forest. In this diagram the sizes of the circles and widths of the arrows are proportional to the quantities of nutrients.**

   (i) **Name the largest store of nutrients shown in Fig. 1.3.**   **[1]**

   Biomass.

   (ii) **Between which two stores is the largest flow of nutrients.**   **[1]**

   Litter to soil.

   (iii) **Use Fig. 1.3 to suggest reasons for the very poor quality soils frequently found in areas of tropical rain forest.**   **[3]**

   The biomass contains the largest store (= 1) and rapidly takes up nutrients from the soil (= 1 mark).
   Large quantities of nutrients are lost from the soil through leaching (= 1 mark).
   Credit other valid reasons.

(c) The model in Fig. 1.4 represents one planning measure used to conserve woodland threatened by human activity.

(i) What is the significance of the core area in the model?

Most valuable area in terms of ecosystems/wildlife or the equivalent.

(ii) Explain how such a strategy could successfully conserve an area of woodland that is threatened by human activity. [5]

Answers need to stress the importance of the buffer zones in protecting the core area from human invasion. If this emphasis is not present in the answer, then award a maximum of 4 marks.

The core area is some distance from developed region; potential visitors are deterred from travelling to the core area plus it contains a woodland research centre emphasising the importance of the core (= 1 mark).

The outer buffer zone contains a mixture of settlements, farmland, and recreational land. This area might act as a honey pot attracting people. (= 2 marks).

The inner buffer zone has limited development, parks and woodland. Smaller numbers are attracted to this area than the outer buffer zone.

[Total: 20]

2 (a) Fig. 2.1 shows the estimated residence times of the world's stores of water.
(residence time is the average time that a unit of water is retained in a store.)

(i) Suggest why it can be helpful to show water resources in the form of residence times rather than by volume. [2]

Residence times emphasise the fragility of some water storage zones (= 1 mark). The top 6 zones in the chart have short residence times and through human activity would soon run out.

(ii) Suggest why biospheric and atmospheric water have very short residence times. [2]

Vegetation has fast rates of uptake and loss through evapotranspiration.

Atmospheric water takes water up through evapotranspiration and loses it quickly through precipitation.

(iii) From evidence provided in Fig.2.1, explain why it is often important to construct reservoirs. [2]

Artificial storage and controlled release of water (= 1 mark) means that the residence time in reservoirs is longer (= 1 mark).

(iv) **Explain why the residence period for soil moisture is given as a range of to 1 year, and groundwater 2 weeks to 10,000 years.**

For each two points are required.

- soil moisture

  Although a temporary store, it takes time for water to infiltrate into the soil for storage (= 1 mark). Capilliary movement is slow and variable according to local drainage, human extraction and climate. The soil moisture store is close to the surface and moisture is stored for less time than groundwater. (= 1 mark).

- groundwater

  Groundwater forms a deep reservoir and therefore it takes longer for water to flow out of the store (= 1 mark; a vital point). The variable time is due to the local relief (slopes intercepting the water table causes springs and a shorter residence time), (= 1 mark) or well dug into an aquifer shorten the time (= 1 mark) or seasonal variations in temperature and rainfall (= 1 mark).

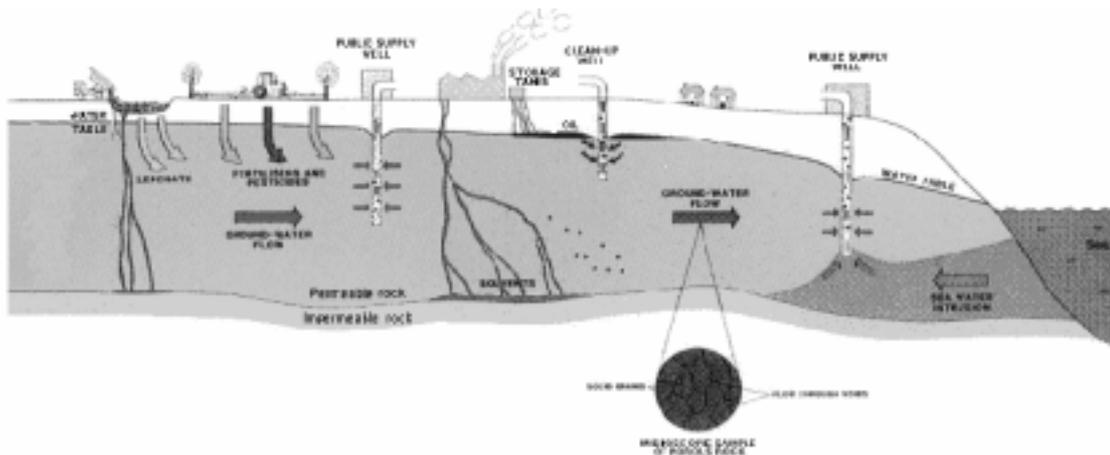**(b) Fig. 2.1 illustrates some of the major causes and forms of groundwater pollution.**

Fig. 2.1

(i) **Name *one* type of groundwater pollution that is derived from:**   [2]

- **agricultural activity,**   pesticides and fertilizers

- **industrial activity.**   solvents/oil/leachates

(ii) **Describe how the extraction of water from a public well supply can affect the water table and increase groundwater pollution.**   [2]

Public well supplies lower the water table in the locality of the well (= 1) and the extracted groundwater is replaced with salty sea water (= 1 mark).

(c) **Mexico City has been one of the world's fastest growing cities. Its population**
20 million. As the climate is dry, water resources for domestic, industr
agricultural use are under great strain. Fig. 2.3 summarises the water supply str
for Mexico City.

Raw Water Sources	Federal District	State of Mexico	Total
Basin of Mexico			
Well fields	22.7	20.3	43.0
Magdalena River	0.2	—	0.2
Madin Dam	—	0.5	0.5
Springs, streams	0.5	0.2	0.7
Imported Sources			
Cutzamala River	7.6	3.0	10.6
Lerma well fields	4.3	1.0	5.3
Total Water Supply	35.3	25.0	60.3

Key

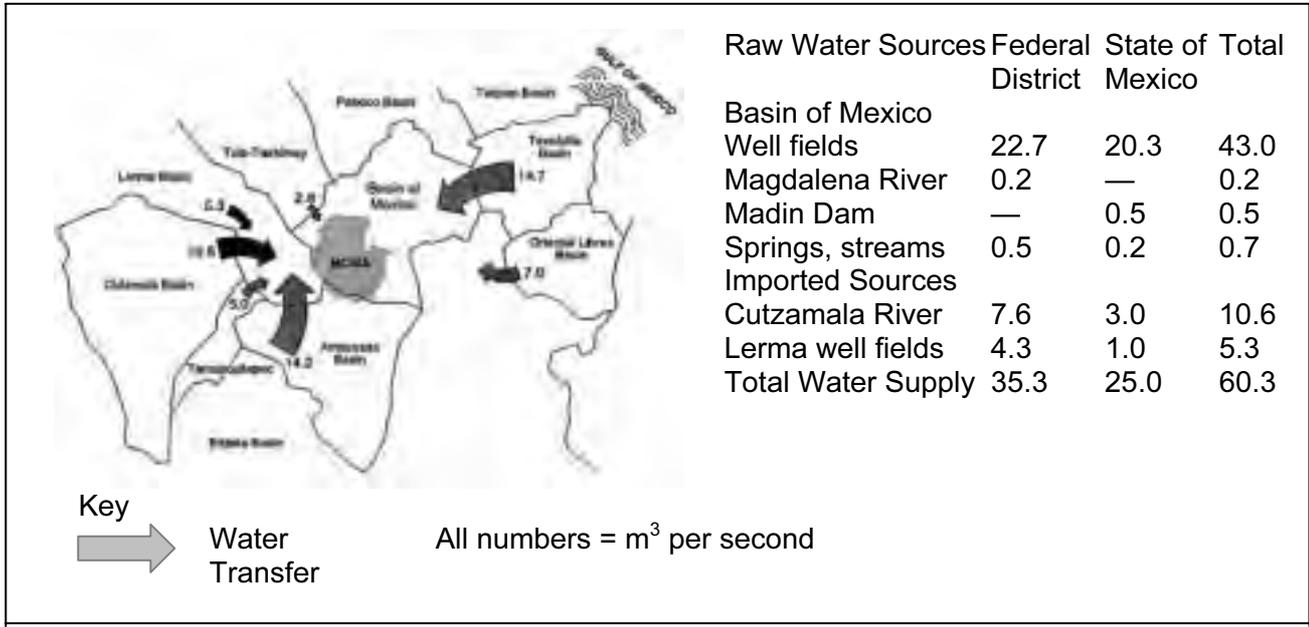→ Water Transfer   All numbers = m^3 per second

Fig. 2.3

(i) **Describe how Mexico City is attempting to meet its demands for water.** [4]

Credit on the basis of up to 2 marks for a well developed point or 1 mark for a relevant statement without elaboration, Candidates can refer to:
- Wells in the Basin of Mexico and imported water from the Lerma wells
- Transfers from local rivers/ drainage basins
- One dam (Madin) provides very little water
- Use of springs.

(ii) **Outline** *two* **issues that may arise in maintaining a clean supply of water for Mexico City.** [2]

Two points and 1 mark for each.
- Rapid city growth leads to increases in domestic waste and water
- contamination (= 1 mark)
- Increased industrialisation and waste (1 mark).
- Extracted groundwater leading to a concentration of pollution in groundwater and river (= 1 mark).

[Total: 20]

Section B
(Answer one question from this section)

3 (a) **Describe the functioning of the coral reef ecosystem shown in Fig. 3.1.**

Reef ecosystems are as complex and diverse as those of the tropical rain forest. Coral feeds off phytoplankton, zooplankton and algae which require solar energy for photosynthesis. This encourages an environment in which some species (sea urchins, sponges) feed directly off coral as well as the algae, zooplankton and phytoplankton.

Thus coral, algae, zooplankton and phytoplankton can be regarded as the producer level of the food chain; sea slugs, sea stars, sea urchins the primary consumers; crabs and angel fish as secondary consumers; giant groupers and octopus are tertiary consumers with the shark the predator at the top of the chain

Award as follows:

The need for solar energy for photosynthesis (+ 2 marks).

Credit one mark for stating a trophic level and one mark for some elaboration. Additionally credit references to the complexity of the food web.

  (b) **Giving examples, explain how and why some marine ecosystems are under threat from human activity. Assess the extent to which the management of human activity has helped the conservation of one named marine ecosystem.**   [30]

For the first part of the question candidates need give a brief survey of how human activity is putting marine ecosystems under threat.

These threats can include:
overfishing e.g. North Sea, Grand Banks, S.E. Pacific. Fishing for herring, cod etc. disrupts the local marine chains, anchovies, local bird life (albatross).
fish netting contributes to accidental catches (e.g. dolphins, porpoise, shark).
oil spillage contaminates the whole food webs, marine and terrestrial e.g. Exxon Valdiz.
industrial spillage can contaminate fishing grounds, etc.
coral reefs damaged through blasting, overfishing, tourism, coral mining, pollution, sediment from agriculture, mineral dredging.
global warming can affect sea temperatures and have a knock-on effect in increasing the strength of storms causing reef erosion.

For the second part of this question candidates need to choose one scheme that a restoration of a single marine ecosystem, perhaps involving:
coral reefs...

- ecotourism in which tourists are advised, escorted and educated in limited numbers
- national park designation
- visitor controls (honey-pot sites and restricted zones)
- restrictions on fishing (catch, net size, bans)
- legislation on extractive activities e.g. mining and dredging

continental shelf ecosystems can be conserved by:

- surveys of vulnerable fish and setting up protected areas
- preserve natural habitats by establishing marine parks
- prevent and control pollution along urbanised and industrialised coasts
- restore habitats which are deteriorating and recreate sites of ecological interest
- no catch zones

Band 1 answers need to balance both parts of the question and should contain detailed references to how human activity can be managed to enable conservation.

Band 3 answers will tend to provide brief but relevant descriptions of the threats to marine ecosystems, and the second part of the question may be generalised or lacking in content.

Band 4 answers will be brief and probably poorly balanced. They will be weak on exemplar material and have very little reference to managing human activity.

[Total: 40]

4 (a) **Fig .4.1 shows how the three conditions of under-population, optimum population and over-population can be related to population size and the wealth of a nation .**
In terms of the extent to which nations utilise their resources, use Fig. 4.1 to explain the terms *under-population*, *optimum population* and *over-population*. [10]

Award 3 marks for each the three conditions and 1 mark for stressing the dynamism of the relationship.

Under-population is where the population is too small (= 1) to utilise its available resources (= 1). The country is therefore less economically developed than it could be (= 1). Some candidates may refer to the potential for further population growth (= 1).

Optimum population is almost a theoretical condition where the population is working with all available resources (= 1/2). Because of this, the country has reached the highest state of economic development and wealth (2/1).

Over-population is where the population exceeds the available resources (= 1). This places a strain on resources (food, etc.) (= 1) and consequently a lower standard of living (= 1).

The dynamism of the concept lies in the variables of population size and technology. Improvements in technology or changes to population size can shift countries between the conditions.

(b) Using examples from Less Economically Developed Countries (LEDCs) a~~nd~~ Economically Developed Countries (MEDCs) assess the extent to which a sust~~ainable~~ future is dependent upon managing population change.

Candidates are now in the position of applying the concepts in part **(a)** to a named example. The question requires a strong element of evaluation of the priorities for a sustainable future. Answers should contain reference to:

- LEDCs and MEDCs and an assessment of whether they are over-/under-/ or at optimum population size.
- the socio-economic conditions of the nations in relation to population size, available and potential resources: what strains are being placed upon the country's resources and environment.
- the priorities for managing the size of the population. Does it need to increase, decrease or remain the same.
- what are the priorities in population management.
- will improvements to technology cope with any foreseeable population changes?
- are the nations resources being fully utilised? If not (which is likely) what developments in resource usage are feasible and sustainable.

Band 1 answers will contain a high level of evaluation and balance the priorities and measures nations need to undertake. There will be a good understanding of the concepts contained in the question, particularly sustainable development.

Band 3 answers are more likely to provide relevant but brief surveys of managing population change, whilst links with resources and technology may be tenuous. There may be loose reference to LEDCs and MEDCs or the examplars may not tightly link with the analysis. Answers will often lack evaluation.

Band 4 answers may consist of lists of information only loosely tied to the question. A poor balance between nations and measures may receive very little evaluation. At this level there should, however, be some relevance.

[Total: 40]

5 (a) What is meant by the term *eutrophication*? Describe the causes and effects of eutrophication in lakes. **[10]**

Credit 4 for a full and correct definition and 6 for the description; noting that the two elements may be combined.

Eutrophication is the nutrient enrichment (= 1) of water in lakes and rivers which causes algae and phytoplankton to multiply (= 1). Algal blooms use up oxygen and block light (= 1), consequently other organisms such as fish are starved of oxygen and die (= 1).

Causes include:
Farmers using fertilisers, particularly nitrates and phosphates, that infiltrate into the soil and seep into rivers and then into lakes. The lack of actively flowing water encourages the growth of algal blooms (= 4).
Other contributions are made by bank erosion/drainage or washings from intensive animal units and increased us of phosphate-containing detergents.

The disposal of sewage and detergents from urban areas can also lead to eutrophication in rivers and lakes.

(b) Outline the main types and causes of pollution in a river with which you ar~~e~~ Describe and evaluate the measures that have been used to reduce pollution~~ ~~ river.

This question should give candidates the opportunity to develop case studies with which they are familiar. Thus the scale of the answer may vary from rivers that are local to the candidate or large scale studied examples.

Well-balanced answers should begin with the causes and scale of pollution in a chosen river. Causes include: municipal pollution, mining, industry, agriculture, silting, radioactive waste, etc.

Measures should be related to the chosen river and can be both local or involve legislation covering the whole drainage basin.

Measures might include: reductions in the use of pesticides and fertilisers, treating sewage, prohibiting the dumping of waste, controls on industrial waste and prohibiting toxic waste and preventing silting.

Band 1 answers should cover all parts of the question, exhibit a full understanding of river pollution and be evaluative of the measures undertaken.

Band 3 answers, although relevant, may be limited in the choice of types of pollution; contain brief or generalised reference to pollution reduction measures and be weak in evaluating these measures.

Band 4 answers should contain some relevant material but it is likely to be brief and lacking in evaluation. Answers may lack an example and be generalised.

[Total: 40]

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**. marshall 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

Band	Level Descriptors	Marks
Band 1	**The candidate demonstrates the following abilities where appropriate to:**	**25–30**
A	• select and use a very good range of accurate and appropriate knowledge; • integrate knowledge from a wide range of areas; • show a good understanding of the concepts involved; • make good use of knowledge derived from personal experience and study;	
B	• select and use a form and style of writing appropriate to purpose and complex subject matter with facility; • communicate complex ideas clearly and accurately, in a concise, logical and relevant way;	
C	• analyse issues and problems well and evaluate them appropriately; • develop complex reasoned arguments and draw sound conclusions on the evidence;	
Band 2	**The candidate demonstrates the following abilities where appropriate to:**	**19–24**
A	• select and use a good range of accurate and appropriate knowledge; • integrate knowledge from a wide range of areas; • show an understanding of the concepts involved; • demonstrate a range of awareness of personally derived and studied knowledge;	
B	• select and use a form and style of writing appropriate to purpose and complex subject matter; • communicate complex ideas clearly and accurately, in a concise, logical and relevant way;	
C	• analyse issues and problems and evaluate them competently; • develop complex reasoned arguments and draw conclusions on the evidence;	

Band	Level Descriptors	
Band 3	**The candidate demonstrates the following abilities where appropriate to:**	13
A	• select and use some accurate and relevant knowledge; integrate knowledge from a limited range of areas; • show an adequate understanding of the concepts involved; • demonstrate a limited range of awareness of personally derived and studied knowledge;	
B	• select and use a form and style of writing appropriate to purpose and subject matter; • communicate the ideas clearly and in a logical way;	
C	• undertake some analysis of issues and problems and make a superficial evaluation; • develop arguments and draw conclusions;	
Band 4	**The candidate demonstrates the following abilities where appropriate to:**	6–12
A	• select a limited range of accurate and relevant knowledge; • integrate knowledge from a very limited range of areas; • show a modest understanding of the concepts involved;	
B	• select and use a limited style of writing, appropriate to purpose and subject matter; • communicate ideas with limited clarity;	
C	• demonstrate limited analysis of issues and problems with limited evaluation; • develop limited arguments and draw limited conclusions;	
Band 5	**The candidate demonstrates the following abilities where appropriate to:**	1–5
A	• select and use some relevant knowledge; • integrate knowledge from a very limited area; • show a restricted understanding of the concepts involved;	
B	When producing written communication: • select and use a very limited style of writing appropriate to purpose and subject matter; • communicate with limited clarity;	
C	• undertake a very limited analysis of issues, problems and evaluation; • recognise some arguments and conclusions;	