

**MARK SCHEME for the May/June 2009 question paper  
for the guidance of teachers**

**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, which would have considered the acceptability of alternative answers.

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.

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### Section A

Answer *all* questions in this section.

1 (a) Fig. 1.1 shows how water enters the groundwater store within a drainage basin.

(i) What is the meaning of the terms *water table* and *aquifer*?

**water table** the upper (variable) level of saturation in the underlying rock or upper level of ground water

**aquifer** the name given to the porous rock that can store water [2]

(ii) Explain why water can pass through a porous rock but not through an impermeable rock.

in porous rocks water passes between the grains through pores whereas in an impermeable rock the pores are too small to permit any downward flow of water. [2]

(iii) Explain why the location of the water table is variable.

as the ground water store is recharged from infiltration and percolation (1)  
it will rise during periods of prolonged rainfall and fall during a dry period (1) [2]

(b) Fig. 1.2 contains some characteristic features of an artesian basin.

(i) Describe the geological conditions that have enabled the development of the artesian basin shown in Fig. 1.2.

answers should refer to two points:

- the synclinal structure enabling an accumulation of groundwater
- bedrock preventing further percolation and water loss
- porous rocks with the recharge areas [2]

(ii) Why do springs occur at the locations labelled?

water flows through the porous rock (1) and seeps out where they reach the surface (1),  
some candidates might mention that seepage increases after period of heavy rainfall (1) [2]

(iii) Suggest *two* reasons why rainfall in the recharge area may not increase the pressure of water seeping from the springs.

the large distance between the recharge zone and the springs means seepage is slow (in fact about 2 million years).

loss into surrounding rocks or surface runoff in recharge area water is extracted through boreholes, wells etc. [2]

(iv) Give *two* reasons for the construction of the boreholes shown in Fig. 1.2.

boreholes penetrate two aquifers

water under pressure will rise through the borehole

domestic and agricultural usage [2]

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- (c) (i) Name *one* pollutant derived from industrial activity, and *one* pollutant derived from agriculture, that might contaminate groundwater.  
**industry**, petroleum, oil, polluted water  
**agriculture**, fertilizers, pesticides or types [2]

- (ii) What is meant by the term *eutrophication*?  
**Explain how agricultural activity can cause eutrophication in a river.**  
 Eutrophication is nutrient enrichment in a river (1)  
 Usually nitrate and phosphate ions derived from fertilisers (1) seep into the river by groundwater flow (or bank erosion) (1), the increase in nutrients produces algal blooms (1) removing oxygen from the water (1) [4]

[Total: 20]

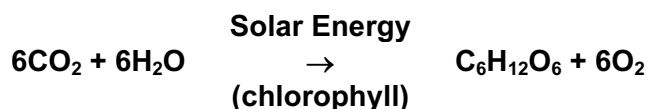
- 2 (a) What is meant by the term *ecosystem*?  
 a community in which energy and matter (1) are transferred in complex interactions between the environment and organisms (1) [2]

- (b) Fig. 2.1 shows how energy and materials move through an ecosystem

- (i) State the primary source of energy for most ecosystems.  
 the sun [1]

- (ii) Describe the flow of energy and materials shown in Fig. 2.1.  
 energy and materials are transferred from producers to consumers-decomposers (1) and directly from producers and consumers to decomposers (1) decomposers supply the nutrient pool (1) [3]

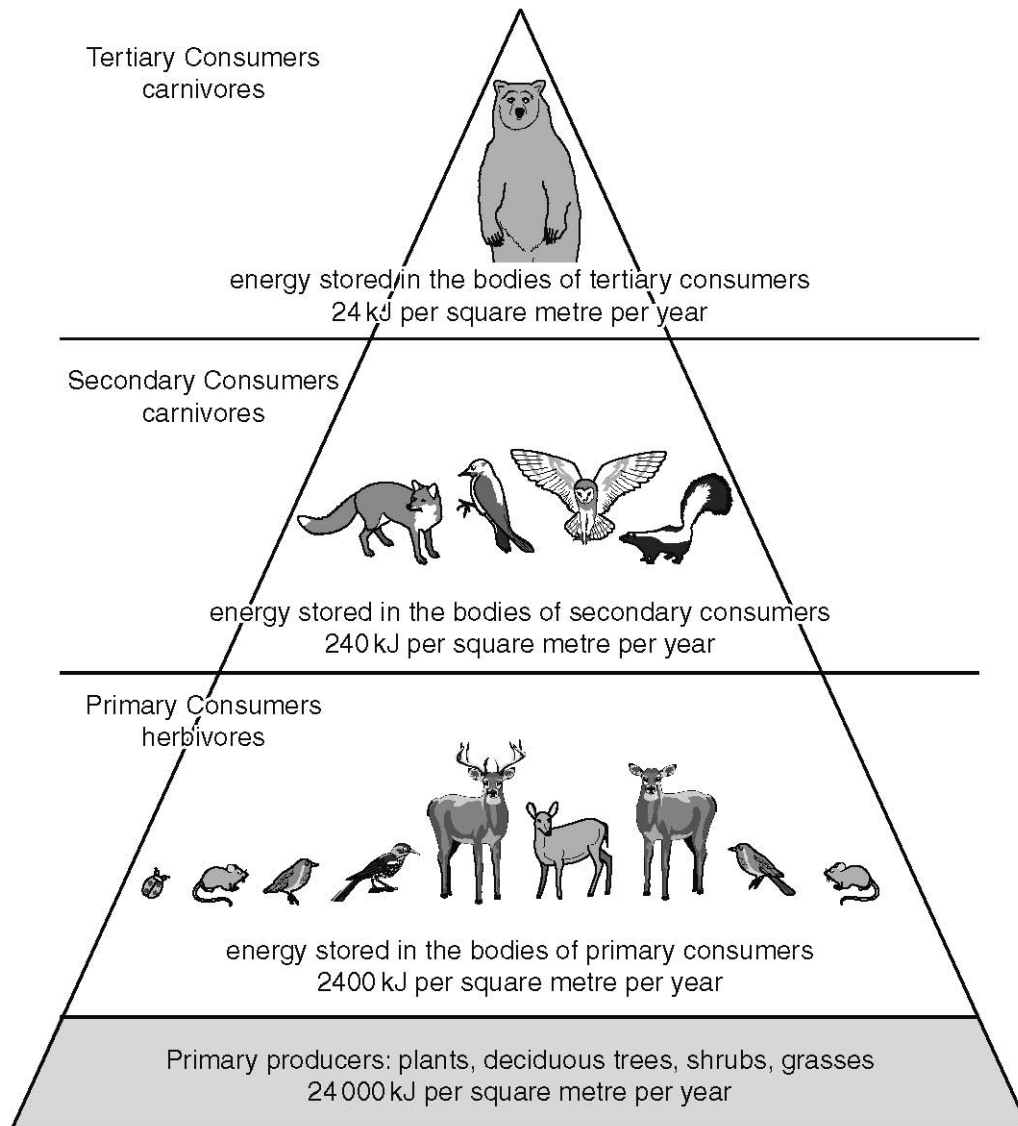
- (c) Explain how the equation below describes the process of photosynthesis.



Although the formula should provide a prompt accept answers that do not make direct reference to it.

autotrophic nutrition (or equivalent) (1) carried out in the chloroplasts of plants; light energy (1) is converted into chemical energy (water + carbon dioxide in the presence of light and chlorophyll) (1) to produce carbohydrates and oxygen (1) [4]

(d) Fig. 2.2 shows an energy pyramid for a North American deciduous forest.



- (i) **With reference to Fig. 2.2 explain what is meant by the term *trophic level*.**  
 a level in a food chain indicating the status at which organisms feed (1) shown as primary consumers etc. or through examples of distinct groups of animals. [2]
- (ii) **By what percentage does the stored energy decrease from one trophic level to the next in Fig. 2.2?**  
 90% [1]
- (iii) **Use Fig. 2.2 to explain the relationship between the number of species and the amount of energy transferred from the primary consumer to the tertiary consumer stage.**  
 The number of species decreases from the producer level to the predator (1), as there is a progressive loss of energy at each level (1) each succeeding trophic level supports fewer species. [3]

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- (iv) **Describe and explain the effect that a warming and drying of the North American deciduous forest region might have upon the energy pyramid shown in Fig. 2.2.**

Credit simple statements with one mark or two marks for a developed point. Effects can occur at each level with different impacts. The example given illustrates the bottom to top approach.

Warming and drying may reduce and alter the producer level (1) thereby removing/modifying habitats for birds, deer etc. (1), causing migration or death (1) as a result secondary and tertiary consumers lose their sources of food and reduce in numbers (1). [4]

**[Total: 20]**

**Section B**

**Answer one question from this section.**

- 3 (a) Using examples from Fig. 3.1, describe how urban and agricultural activities can be both point and non-point sources of pollution. [10]**

*non-point pollution is experienced at some distance from its actual source  
point source pollution occurs at the place of emission*

sources of river pollution	
agricultural processes	urban processes
<p>farm fields</p> <p>livestock manure and trampling</p>	<p>residential runoff</p> <p>industrial &amp; commercial runoff</p> <p>construction runoff</p>

**Fig. 3.1**

Point sources are where pollution is coming from a concentrated originating point like a pipe from a factory or a large registered feedlot (American) with a specific point of discharge. It pollutes the immediate vicinity of the source; thus sewage, industrial effluent and will directly pollute rivers (visual, smell, toxicity). Trampling widens/compacts ground and manure is spread directly onto fields.

Non-point sources are where the form of pollution is derived from a distant location. Rivers will transport pollutants (sewage) and deposit it in the sea, lakes or rivers. Effluent, fertilisers and pesticides enter rivers and lakes after groundwater seepage and transport.

Notionally credit 5 marks for each

- |               |  |
|---------------|--|
| 8 to 10 marks | A good balance, clear definition and use of examples.                              |
| 4 to 7 marks  | One element stronger than the other, unclear definitions and weak use of examples. |
| 1 to 3 marks  | Brief and/or poorly balanced. Poor use of examples.                                |

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- (b) *"Managing our water better has great benefits for wildlife, for fish and for jobs – we can no longer afford to misuse such a priceless resource."*  
**With reference to examples with which you are familiar, describe and assess the success of measures that aim to reduce river pollution. [30]**

The choice of the example is up to the candidate. The initial statement is a prompt which should provide candidates with some direction.

Managing river pollution involves a number of stages to be successful.

Levels of pollution need to be determined which might include measurements of visual pollution, BOD, biodiversity and species population.

The sources of pollution need to be identified; point or non-point; continuous or accident.

Management is directed towards both the point source and the non-point source. Point sources can be managed by legislation on the quality and volume of outflow and non-point by cleaning, location/length of pipelines, toxic waste legislation, street cleaning, controlling runoff, equipment maintenance, organic methods of pest control etc. Other measures include: public education, recycling.

Evaluations should point to levels of success/failure with reasons.

- Band 1 answers should consider the management strategies outlined above and through the example make clear assessments of cause, management and level of success. (25–33)
- Band 3 answers, although relevant, may focus on one or two elements of management, exhibit a weak development of the case study and make generalised assessments. (13–18)
- Band 4 answers should contain general reference to the pollution issues of a chosen example but be brief and unclear about management policies. (6–12)

**[Total: 40]**

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- 4 (a) Describe how deforestation in a Tropical Rain Forest would affect the stores and flows of nutrients shown in Fig. 4.1. [10]

Answers should recognise that:

- the biomass is the largest nutrient store
- due to rapid decomposition the litter store is the smallest
- there is a large flow of nutrients into the soil store that is taken up by the biomass
- nutrients are washed out from the soil and litter

Consequently if the biomass is removed the major store of nutrients is removed. Nutrients are then removed from the soil by erosion/percolation and an already sterile soil rendered completely infertile. There is no replenishment via litter.

Notionally award 4/5 marks for the cycle description and 6/5 for disruption to the cycle.

- |               |  |
|---------------|--|
| 8 to 10 marks | an effective and balanced consideration of flow and stores with clear references to disruptive effects.                            |
| 4 to 6 marks  | flows and stores are briefly or vaguely described, perhaps stronger on disruptive influences; occasionally poorly balanced answers |
| 1 to 3 marks  | limited understanding of flows and stores and weak references to disruptive influences.  |

- (b) Describe how human activity can have a destructive effect upon an ecosystem or biome you have studied. Assess the measures that have or might be adopted to limit these effects. [30]

Although candidates may well select the TRF they have the opportunity of using a local example.

Human activity can include, deforestation, urbanisation, quarrying, reservoirs, agriculture.

Effects will be disruption to the whole ecosystem or biome (not simple the nutrient flow) including habitats, food chains/webs, resources, aesthetics.

Measures usually include legislation involving conservation and preservation: designation and administration of National Parks and other conservation sites, education, national and international controls and pressure, ecotourism etc.

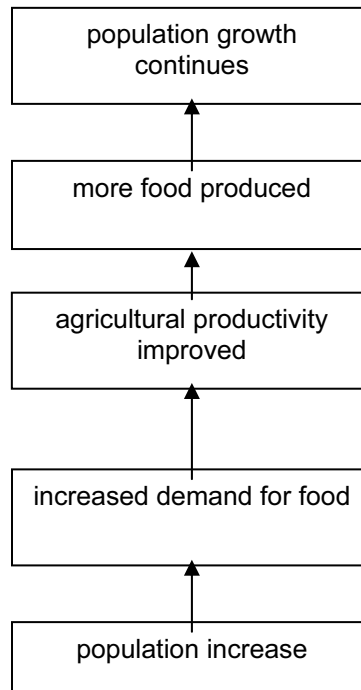
- |        |   |
|--------|---|
| Band 1 | answers should contain a well balanced and detailed consideration of a selected ecosystem/biome. There must be a strong element of evaluation. (25–30)                          |
| Band 3 | answers will cite an example but lack detail on pressures on the environment and clarity about relevant conservation measures. Assessments will tend to be generalised. (13–18) |
| Band 4 | answers may concentrate upon one or two elements and lack specific locational references. There will be very little assessment. (8–12)  |

[Total: 40]



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- 5 (a) Using examples, explain how the stages shown in Fig. 5.1 provide an optimistic view of population growth and economic development for a country or region. [10]



**Fig. 5.1**

'Necessity is the mother of invention' sums up this optimistic scenario.

The question requires the use of an example and an explanation that begins with the issue of increasing population that leads to pressures on food resources both home produced and imported, the optimistic scenarios ensue from this point.

Credit should be given for the application of the model to a country or region not to repeating per se the content of Fig. 5.1.

- 8 to 10 marks      answers make effective use of an example in each of the five stages.
- 4 to 7 marks        answers use an example in general terms with reference to at least three of the stages.
- 1 to 3 marks        answers may not recognise the optimism in the model and in simple term expand the stated detail.

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- (b) For either a developing country (LEDC) or developed country (MEDC) of your choice, describe the pressures that population growth is placing upon *either* its water resources *or* biological resources. Assess the measures that are aimed at reducing these pressures. [30]

Although there are considerable global variations in population growth the question is concerned with the effects of over/optimum and under population on water or biological resources.

China and India have large populations and are concerned about growth prognoses.

Much of sub-saharan Africa has major current problems due to drought and desertification of savanna and sahel. Developed nations also face prospective difficulties as, although population growth might be slow, meeting current demand and the effects of climatic change are problematic.

Answers should:

For water

- address the population issue
- review demands for quantity and quality of water
- describe current and plant water supply strategies
- evaluate the strategies

For biological

- assess pressures on ecosystems and/or biomes
- assess pressures on agriculture, forests and fisheries
- describe current strategies for sustainable use and conservation
- evaluate the strategies

Band 1 answers must refer to a country and develop each bullet point with a specific concern for sustainability. (25–30)

Band 3 answers should name a country but reference to it may be general and cover at least two of the bullet points. Expect some limited evaluation. (13–18)

Band 4 answers will tend to be brief and poorly balanced. Evaluations may be absent. (8–12)

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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>
A	<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	<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>	
C	<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>
A	<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	<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>	
C	<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>
A	<ul style="list-style-type: none"> <li>select and use some accurate and relevant knowledge; 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	<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>	
C	<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>
A	<ul style="list-style-type: none"> <li>select a limited range of 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	<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>	
C	<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>
A	<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	<p>When producing written communication:</p> <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>	
C	<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>	