

# **MARKSCHEME**

**May 2004**

## **ENVIRONMENTAL SYSTEMS**

**Standard Level**

**Paper 2**

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If you do not have a copy of the current Environmental Systems guide,  
please request one from IBCA.

## General Marking Instructions

*After marking a sufficient number of scripts to become familiar with the markscheme and candidates' responses to all or the majority of questions, Assistant Examiners (AEs) will be contacted by their Team Leader (TL) by telephone. The purpose of this contact is to discuss the standard of marking, the interpretation of the markscheme and any difficulties with particular questions. It may be necessary to review your initial marking after contacting your TL. **DO NOT BEGIN THE FINAL MARKING OF YOUR SCRIPTS IN RED INK UNTIL YOU RECEIVE NOTIFICATION THAT THE MARKSCHEME IS FINALIZED.** You will be informed by e-mail, fax or post of modifications to the markscheme and should receive these about one week after the date of the examination. If you have not received them within 10 days you should contact your Team Leader by telephone. Make an allowance for any difference in time zone before calling. **AEs WHO DO NOT COMPLY WITH THESE INSTRUCTIONS MAY NOT BE INVITED TO MARK IN FUTURE SESSIONS.***

You should contact the TL whose name appears on your "Allocation of Schools listing" sheet.

### **Note:**

Please use a personal courier service when sending sample materials to TLs unless postal services can be guaranteed. Record the costs on your examiner claim form.

1. Follow the markscheme provided, do **not** use decimals or fractions and mark only in **RED**.
2. Where a mark is awarded, a tick (✓) should be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark.
3. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases write a brief annotation in the **left hand margin** to explain your decision. You are encouraged to write comments where it helps clarity, especially for moderation and re-marking.
4. Unexplained symbols or personal codes / notations on their own are unacceptable.
5. Record subtotals (where applicable) in the right-hand margin against the part of the answer to which they refer (next to the mark allocation for Section A). Do **not** circle sub-totals. **Circle the total mark for the question in the right-hand margin opposite the last line of the answer.**
6. For Section B, show a mark for each part question (a), (b), *etc.*
7. Where an answer to a part question is worth no marks, put a zero in the right-hand margin.
8. Section A: Add together the total for each question and write it in the Examiner column on the cover sheet.  
Section B: Insert the total for each question in the Examiner column on the cover sheet.  
Total: Add up the marks awarded and enter this in the box marked TOTAL in the Examiner column.
9. After entering the marks on the cover sheet, check your addition to ensure that you have not made an error. Check also that you have transferred the marks correctly to the cover sheet. **We have script checking and a note of all clerical errors may be given in feedback to examiners.**
10. Every page and every question must have an indication that you have marked it. Do this by **writing your initials** on each page where you have made no other mark.
11. If a candidate has attempted more than the required number of questions, mark only the required number in the order in which they are presented in the paper, **unless the candidate has indicated on the cover sheet the questions to be marked.**
12. A candidate can be penalized if he/she clearly contradicts him/herself within an answer. Make a comment to this effect in the left hand margin.

## Subject Details: Environmental Systems SL Paper 2 Markscheme

### General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- ◆ Each marking point has a separate line and the end is signified by means of a semicolon (;).
- ◆ An alternative answer or wording is indicated in the markscheme by a “/”; either wording can be accepted.
- ◆ Words in ( ... ) in the markscheme are not necessary to gain the mark.
- ◆ The order of points does not have to be as written (unless stated otherwise).
- ◆ If the candidate’s answer has the same “meaning” or can be clearly interpreted as being the same as that in the mark scheme then award the mark.
- ◆ Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalizing them for what they have not achieved or what they have got wrong.
- ◆ Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
- ◆ Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with “**ECF**”, error carried forward.
- ◆ Units should always be given where appropriate. Omission of units should only be penalized once. Indicate this by “**U-1**” at the first point it occurs. Ignore this, if marks for units are already specified in the markscheme.
- ◆ Do not penalize candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

SECTION A

1. (a) *Answers must mention both organisms and their environment for [2].*  
a community of interdependent organisms;  
and the physical environment they inhabit;  
**or**  
segment of nature with its included organisms;  
in their abiotic environment; [2 max]  
*Any other reasonable definition.*
- (b) *Answers must mention the idea of a grouping / collection of ecosystems, and similarity of climate / environment to achieve [2].*  
a collection of ecosystems;  
sharing similar climatic conditions;  
**or**  
a major grouping of communities / ecosystems;  
with similarities of structure and environment / climate; [2 max]  
*Any other reasonable definition.*
- (c) *name: desert / semi-desert;*  
*Award [1] each for any two of the following.*  
vegetation generally low/stunted;  
plants capable of storing water;  
cacti;  
xerophytes;  
absence of tall trees;  
animals adapted to desert conditions;  
absence of visible water;  
extensive areas of bare ground;  
low precipitation;  
high mean temperature range;  
high rates of insolation; [3 max]  
*Any other reasonable suggestions.*
- (d) (i) low [1]
- (ii) *Points, e.g. relating to climate, which have already been awarded credit in 1(c), should not be credited again.*  
*High/low or equivalent must also be given e.g. "temperature" alone is insufficient for credit.*  
precipitation / rainfall very low;  
high daytime temperatures (so evaporation / transpiration / evapo-transpiration high);  
low plant biomass for photosynthesis;  
low water-holding capacity of soil;  
low soil fertility (*allow, although fertility of some desert soils may be quite high*); [2 max]  
*Any other reasonable point.*

2. (a) energy intake much higher in North America / much lower in Africa;  
in 1970 the energy intake in North America was already higher than that predicted for Africa for year 2050;  
slight increase in total intake in Africa;  
slight increase from 1970 to 1990 in North America, thereafter steady;  
proportion of energy from meat much higher in North America / much lower in Africa;  
proportion of energy from vegetables much higher in Africa / much lower in North America;  
slight decrease in energy from animal products in North America; **[4 max]**  
*Any other reasonable point.*
- (b) North America much more advanced technologically / uses more pesticides / fertilizers / machines;  
economic differences – much greater affluence in North America so can afford more meat (and higher total amount of food);  
cultural differences – meat-eating is part of North American lifestyle;  
Africa a developing country, but North America a developed country; **[1 max]**  
*Any other reasonable point.*

3. (a) Award **[1]** for any three of the following.  
CO<sub>2</sub>, CO, CH<sub>4</sub>, CFCs, water (vapour), N<sub>2</sub>O, NO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub>, ozone; **[1 max]**  
Accept either names or formulas.
- (b) Answers must state more than “fossil fuels” to achieve the mark.  
e.g. increased CO<sub>2</sub>, through increased combustion of fossil fuels (oil, coal, natural gas);  
e.g. increased CO<sub>2</sub>, through increased use of private cars;  
e.g. increased CH<sub>4</sub>, through incomplete decomposition of organic materials from some agricultural activities / farm stock / paddy fields; **[1 max]**
- N.B.** There is some evidence that efforts to bring about the reduction in the use of CFCs are now being successful, so allow: “restrictions on the use of CFCs as propellants and in refrigerators / air conditioners, leading to **reductions** in the amounts entering the atmosphere”.
- (c) increase in global temperatures / global warming;  
trapping of heat in the lower atmosphere, by preventing long wave radiation escaping;  
thermal expansion of the oceans;  
melting of ice-caps (e.g. Greenland / Antarctica);  
retreat of valley glaciers (Alps, New Zealand);  
long-term rise in sea-level / flooding of lowland areas / low islands;  
change in the distribution of world biomes;  
change in the pattern of agricultural production; **[2 max]**  
Any other reasonable point.  
Award **[0]** for “greenhouse effect” alone. Reject “Health effects on humans”.

4. (a) a community of organisms that has reached a more-or-less stable composition; and that is in equilibrium with natural environmental conditions such as climate; the endpoint of ecological succession; **[2 max]**
- (b) *Award [1] for named habitat, and [2] for species change. Do not insist on actual species names, but answer must include two or three organisms (plants or animals) to achieve [2]. The species will of course vary with the location: an "old field" community in the USA is as valid as the sand dunes on the African coast.*
- examples:*  
freshwater;  
aquatic plants such as *Nymphaea*/water lilies → *Phragmites*/reeds → low woodland species e.g. *Salix*/willow;  
old quarry;  
mosses and lichens → grasses and herbs → shrubs (e.g. *Betula*/birch ) → woodland; **[3 max]**
- N.B.** *Some responses have confused succession with evolution. Responses that describe evolution of new species rather than colonization by new species as succession proceeds should not receive credit.*
- (c) *examples:*  
terrestrial – as a terrestrial community matures the number of trees and shrubs increases;  
causing a decrease in the amount of light reaching the ground;  
**or**  
aquatic – as the vegetation on the margins of a small pond develops, and dead organic matter accumulates;  
the depth of water decreases; **[2 max]**  
*Allow any reasonable example.*

5. (a) *feedback:*  
the return of part of an output of a system (or subsystem) as an input, so as to affect succeeding outputs / *OWTTE*;

[1]

(b) *Answers must have a definition, some explanation of negative feedback and an example (which need not be as detailed as that below) to achieve full marks.*

*negative feedback:*

feedback that tends to damp down, neutralize or counteract any deviation from an equilibrium and promotes stability / *OWTTE*;

*example:*

increase in number of predators (*e.g.* owls) → decrease in small mammals (*e.g.* mice, voles, shrews) → increase in small mammals → increase in predators;

*explanation:*

understanding of ecological relationships / processes;

[3 max]

*For the final mark the answer must show some understanding of ecological relationships or processes, such as predation, disease, breeding success. This material may be incorporated in the example. Some or all of the information may be given in the form of a diagram.*

## SECTION B

### General Essay Markscheme

Each essay is marked out of **[20]** of which **[3]** are for expression and development of ideas (EDI).

- [0]** No expression of relevant ideas.
- [1]** Expression and development of relevant ideas is limited.
- [2]** Ideas are relevant, satisfactorily expressed and reasonably well developed.
- [3]** Ideas are relevant, very well expressed and well developed.

*Reward detail, sound environmental / ecological concepts, and good examples even if not stated exactly in the form given in the markscheme.*

6. (a) *To achieve [5] answers must have examples and at least one point distinguishing chains from webs.*

*food chain: [1]*

a single series of organisms within an ecosystem linked by feeding / trophic relationships;

*example: [1] for African river*

water plants → aquatic insects → small fish → larger, predacious fish → Nile crocodile;

*food web: [1]*

made up of the many food chains in an ecosystem as food chains branch and reunite / the network of food consumption in an ecosystem;

*example: [1]*

in the African river, many species (including hippopotami), may consume the aquatic plants, and many bird species (egrets, herons, kingfishers) may consume fish;  
*Answer may be expressed in diagram form.*

*One of the following distinguishing points: [1]*

food chains seldom have more than four or five members, food webs may contain dozens of species;

organisms in a food chain feed at only one trophic level, but in a web may feed at several levels;

*Any other appropriate point.*

**[5 max]**

(b) To achieve [8] answers must have an understanding of the first law and a diagram.

definition: [1]

the first law of thermodynamics / law of conservation of energy states that energy may be converted from one form to another but cannot be created or destroyed;

explanation: [4 max]

energy flows along a food chain, and although it may be passed from trophic level to level, the energy is never destroyed;

thus sunlight energy is fixed by photosynthesizing plants / primary producers;

although some energy is reflected;

and some metabolized;

and expelled as heat;

some of this photosynthetic energy is stored by the plant biomass;

herbivores / primary consumers gain energy from consuming plant material;

but much energy is lost as heat with each transfer;

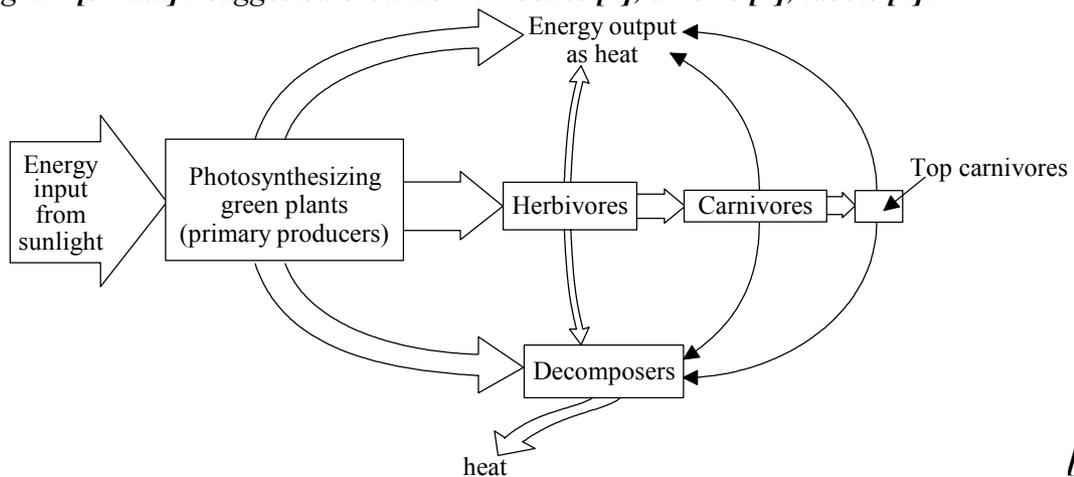
carnivores / secondary consumers consume herbivores;

but again much energy is lost as heat to the environment with each transfer;

decomposers break down the complex chemicals in other organisms, releasing heat;

inputs of the system as a whole, and of any individual trophic level, equal outputs;

Diagram [3 max]: suggested breakdown – boxes [1], arrows [1], labels [1].



[8 max]

Accept pyramids of energy provided same detail is given.

Where responses confuse nutrient flow with energy flow, allow [7 max].

- (c) species are linked to one another in ecosystems in complex, intimate ways;  
a species may be dependent on others for food;  
shelter;  
nesting / roosting sites;  
pollination;  
as parasites;  
symbionts;  
thus the extinction of one species may cause a reduction in those dependent on it;  
conversely the extinction of a predator, may cause an increase in the abundance of  
species on which it feeds;  
or those which compete with it;  
*Any other reasonable points.*  
*Allow [2 max] for good examples.*

**[4 max]**

*Expression of ideas [3 max]*

**Total [20]**

7. (a) industrial plants / power-stations / motor cars (automobiles) in many parts of the world;  
as the result of the burning of fossil fuels;  
produce gases such as sulfur dioxide / nitrogen oxides (*accept formulas*);  
these combine with moisture in the atmosphere to form sulfuric / nitric acid;  
alternatively dry nitrates and sulfates may be deposited;  
prevailing wind systems / depressions may carry the acidity many thousands of km;  
*examples:*  
from industrial regions of northern England and Scotland to Scandinavia / from USA to parts of Canada;  
sketch-map to illustrate this;  
local effects may be influenced by topography / microclimate / geology / soil; **[6 max]**  
*Any other reasonable point.*
- (b) effects may be direct or indirect;  
acidified lakes / lowered pH of lakes;  
death of some aquatic organisms;  
acidification of soil mobilises Al ions;  
toxic effect of aluminium ions on fish;  
loss of leaves / needles from trees;  
change in species composition of forest;  
damage to crops / agriculture / horticulture;  
leaching of nutrients from soils;  
damage to stone monuments and buildings; **[5 max]**  
*Any other reasonable point.*
- (c) reduction in fossil fuel consumption;  
switch to renewable energy sources such as wind / sunlight or to nuclear power;  
reduce private car use;  
remove sulfur and nitrogen compounds at early stage of processing;  
“scrubbers” to remove pollutants;  
“clean air” legislation in many jurisdictions;  
international agreements such as Convention on Long Range Air Pollution;  
use of lime to reduce acidity of lakes; **[6 max]**  
*Any other reasonable points.*  
*However, “build tall chimneys to disperse emissions” is not acceptable.*

*Expression of ideas* **[3 max]**

**Total [20]**

8. (a) renewable natural capital = living populations / ecosystems / which reproduce and maintain themselves;  
*e.g.* forests / animal populations / fisheries;
- replenishable natural capital = non-living resources / usually depend on solar energy for their replenishment;  
*e.g.* groundwater / ozone;
- non-renewable = resources that cannot be replaced on a timescale of the same order at which they are consumed;  
*e.g.* fossil fuels / minerals;

[6]

- (b) *Question asks for how sustainability can be assessed, not for the techniques of sustainable management themselves, which many candidates are giving. Do not credit for descriptions of sustainable management techniques.*

sustainable management = management of a resource in such a way that the long-term productivity/viability of the natural capital is not compromised / *OWTTE*;

*example of sustainable yield management for forest resource:*

determine biological productivity of the forest ecosystem / rate at which timber is produced by photosynthesis (A);

determine rate at which timber is being removed (B);

if  $B > A$  forest is not being managed sustainably;

allow for other crops from forest (*e.g.* game / water);

*Allow any other appropriate points.*

[5 max]

- (c) some forms of natural capital can be evaluated in economic / money terms;  
*e.g.* timber / fish / game / water;  
thus an estimate of the economic value of the natural capital can be made;  
in other cases it may be difficult or impossible to measure the services provided by a resource;  
*e.g.* the value of forests in maintaining the purity of water;  
and the protection of soils;  
aesthetic values are very hard to quantify;  
*e.g.* the aesthetic value of a beautiful mountain or lake view;  
note also possible value of a resource in the very long-term / to future generation in ways not at present understood;  
moral / religious / ethical values impossible to quantify;  
and vary from one culture to another;
- Any other reasonable points.*  
*Do not allow same point in (b) and (c).*

[6 max]

*Expression of ideas [3 max]*

**Total [20]**

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