

# **MARKSCHEME**

**May 2004**

## **ENVIRONMENTAL SYSTEMS**

**Standard Level**

**Paper 3**

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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 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. Do **not** circle subtotals. **Circle the total mark for the question in the right-hand margin opposite the last line of the answer.**
6. Where an answer to a part question is worth no marks, put a zero in the right-hand margin.
7. For each Option: Write the number of marks awarded in the Examiner column on the cover sheet.  
Total:                    Add the marks awarded for the two options and enter this in the box marked TOTAL in the Examiner column on the cover sheet.
8. 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.**
9. 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.
10. If a candidate has attempted more than the required number of Options, 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 options to be marked.**
11. 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 3 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:

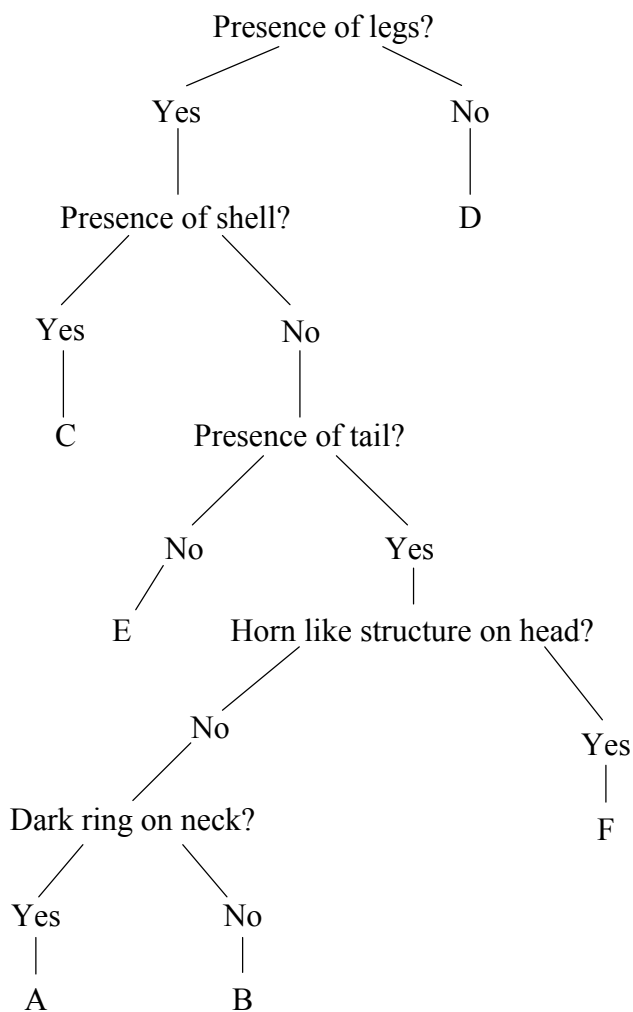
- ◆ Each marking point has a separate line and the end is signified by means of a semicolon (;).
- ◆ An alternative answer or wording is indicated in the markscheme by a “/”; either wording can be accepted.
- ◆ Words in ( ... ) in the markscheme are not necessary to gain the mark.
- ◆ The order of points 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 penalising 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.

**Option A – Analysing Ecosystems**

- A1. (a)** *Clear use of characteristics (only accept characteristics visible in the figure) [3 max] e.g.*  
presence or absence of legs;  
horn on head;  
shape;  
shell;  
tail;  
dark ring on neck;  
*Any other valid suggestions.*

appropriate key structure; (either of the two formats shown below)  
*Do not accept a table or list that simply describes the organisms.*

**[4 max]**



- 
1. Presence of legs? If no → D, if yes → 2
  2. Presence of shell? If no → 3, if yes → C
  3. Presence of tail? If no → E, if yes → 4
  4. Presence of horn on head? If no → 5, if yes → F
  5. Dark ring on neck? If no → B, if yes → A

- (b) field guide;  
compare specimen with illustration;  
take sample for lab identification;  
photography;  
reference collection or herbarium;  
characteristics such as behaviour / sound / distribution / time of the year;  
compare with known species;  
consider habitat;  
genetic analysis / DNA; [1 max]  
*Any other suitable suggestions.*
- (c) (i) pH;  
temperature;  
light;  
soil;  
salinity;  
nutrients (in the case of a plant species);  
water; [1 max]  
*Any other relevant factor appropriate to the selected organism.*  
*Award [0] for stating the organism's name.*  
*Do not be too strict on the name of the organism - candidates are not asked for a species name, fish and crab are acceptable.*
- (ii) *The method has to be appropriate to the named factor.*  
*e.g. temperature.*  
use thermometer;  
repeat measurements regularly over 24 hours;  
take several measurements and calculate the mean;  
repeat measurements at different times of year; [2 max]  
*If organism is paired with an inappropriate factor in (c)(i), allow credit for outlining the factor in (c)(ii) - error carried forward (ECF).*
- (iii) *Award [1] for name of activity e.g.*  
farming / hunting / agriculture / urbanization / introduction of alien species / tree felling / use of pesticides;  
*Do not accept "pollution" - too vague.*  
*Award [2] for effect on organism.*  
*e.g. if organism is an insectivorous bird;*  
insecticides used to control insects accumulates in predators;  
so number of predators would decrease leading to an increase in insect numbers; [3]

**A2. (a) Description:**

simple count at ground level;  
tag / mark counted individuals;  
use of aircraft / count from air;  
count individuals in a known area and extrapolate for the area of the whole park;  
use information from previous census / survey;  
capture – mark – release – recapture / Lincoln index;

*Evaluation:*

problems due to very large areas;  
capture – mark – release – recapture method possibly inappropriate for large mammals;  
density of population in different habitats might vary;  
some individuals might be concealed by vegetation;  
seasonal variations / migration habits of elephants;  
problem of replicating sampling;  
high cost of some methods;

**[4 max]**

*To receive full marks, answers must have at least one evaluation, i.e. award only [3 max] for describing method.*

- (b) count and identify organisms;  
in a specified period of time;  
defined number of collectors;  
calculate relative abundance of organisms;  
use of Simpsons diversity index;

$$D = \frac{N(N-1)}{\sum n(n-1)};$$

other appropriate diversity index;  
higher index value implies greater diversity / *OWTTE*;  
sample areas / quadrant;  
replicate countings in both ecosystems under similar conditions;  
compare values;  
replicate countings in both ecosystems under similar conditions;  
compare values;

**[5 max]**

*Any other reasonable points.*



**Option B – Impacts of Resource Exploitation**

**B1. (a)** Africa; **[1]**

(b) *Description:*  
*For example:*

Asia is the major aquaculture producer in the world;  
Asia accounts for about 90 % of the world production;  
the production of fish has increased in every continent;  
total production has increased substantially;  
*Any other valid point.*

*Explanation:*

cultural / historical factors may affect the development of aquaculture;  
Asia has a long tradition of aquaculture;  
aquaculture may represent an excellent source of protein for highly populated areas such as Asia;  
the slower growth rate in some regions may be due to limited water supply;  
low national priority of aquaculture / technical and financial constraints in some areas;  
in some countries economic incentives / support / subsidies have been provided for aquaculture;

total increase due to rising human population;

**[4 max]**

*To receive full marks, answers must include at least one explanation point.*

(c) *Advantage:*

excellent source of nutrients (*e.g.* protein);  
produces high yields in a small volume of water;  
genetic engineering can help increase yields / production;  
allows access to fish as a food in areas without coast or limited freshwater;  
ensures a constant / on demand / non-seasonal supply of food / *OWTTE*;  
generation of employment:  
little fuel is needed;  
one of the fastest growing food-producing sectors;  
energy conversion sometimes more efficient;

**[1 max]**

*Disadvantage:*

initial costs;  
maintenance;  
waste can contaminate nearby estuaries / groundwater / surface water;  
require large inputs of land / water / feed / energy;  
dense population makes fish more prone to bacterial and viral infections;  
escapees can affect wild populations (*e.g.* Atlantic salmon escaping into British Columbia affect wild Pacific populations);  
food obtained from high trophic levels;

**[1 max]**

(d) over-fishing is harvesting at a rate that exceeds the estimated sustainable yield;  
over-fishing may mean that little breeding stock is left to maintain numbers;  
prolonged over-fishing can lead to depletion / extinction;  
thus levels are lower in 1998 than in 1950;  
large increase in catch from 1950 to 1968 / around 1968 were the years of highest catch;  
lower catch may be due to stricter control;  
declining catch may provide evidence of lack of sustainability / *OWTTE*;  
lower catch may be due to effects of over exploitation; **[3 max]**  
*Any other reasonable suggestions.*

**B2.** (a) (i) the area of land and water required to support a defined human population at a given standard of living / *OWTTE*; **[1]**

(ii) population;  
CO<sub>2</sub> emissions;  
CO<sub>2</sub> absorption capacity;  
Relative wealth / *per capita income* / stage of development;  
food production;  
Fossil fuel use; **[2 max]**  
*Allow reasonable suggestions such as area suitable for food production / CO<sub>2</sub> absorption.*

(b) *For example:*  
Denmark and New Zealand have the highest ecological footprint (developed countries);  
Namibia and Ecuador have the lowest ecological footprint (least developed countries);  
ecological footprints ranged from 0.7 to 10.5 hectares *per capita*;  
Denmark and Hong Kong import most of their requirements and export waste and thus influence areas beyond borders;  
developed countries use more fossil fuels;  
so need more vegetation to absorb CO<sub>2</sub> from burning fossil fuels;  
developed countries have larger footprint than developing;  
developed countries import more;  
developed countries consume more food, especially animal products;  
so require more land for food production; **[4 max]**  
*Any other suitable points.*  
*To receive full marks, answers must include at least one explanation point.*

(c) *A country must be named, if not award [2 max]. If only a country is given, award [0]. Factors listed depend on the country chosen but might include:*  
increased use of genetic engineering;  
increased organic food production;  
new strains of plants and animals;  
advances in technology;  
increased use of irrigation;  
improvements in food distribution;  
cultural changes e.g. increase of biological agriculture;  
new fertilizers;  
increase in intensive methods / greenhouse / aquaculture; **[3 max]**  
*Any other reasonable points.*

**Option C – Conservation and Biodiversity**

**C1.** (a) *endangered* is a (wild) species with so few individual survivors that soon it could become extinct;

*threatened* is a (wild) species that is still abundant but is likely to become endangered because of a decline in numbers;

*extinct* is the complete disappearance of a species from the Earth; **[3]**

- (b) low numbers;  
low reproduction rates;  
human pressure on habitats;  
economic value;  
limited distribution;  
long and complex migration route;  
specialized (ecological) niches;  
specialized habitats;  
*Any other reasonable point.*

**[3 max]**

- (c) difference in area of continents;  
Antarctica is covered in ice;  
Europe has a much higher human population;  
industry in Europe;  
Antarctica has an extreme environment;  
biodiversity is low in Antarctica  
*Any other reasonable point.*

**[2 max]**

- C2. (a) Award [1] for name e.g. *Peregrine falcon*.  
 legislation (e.g. ban hunting);  
 cloning;  
 artificial breeding / zoos;  
 creating new reserves / parks;  
 protection of habitats;  
 reduction in use of toxic substances (e.g. DDT);  
 Any other reasonable suggestion.

[3 max]

- (b) Answers only need to show **one** advantage and **one** disadvantage for each of the listed approaches to conservation.

	<i>Advantage</i>	<i>Disadvantage</i>
<i>Zoos</i>	controlled breeding; allow for research; allow for education; extreme protection for individuals;	problems reintroducing animals to wild; prisons for animals; sends wrong message – “we don’t need to worry”; tend to favour “popular” animals; small genetic pool;
<i>Creation of reserves or protected areas</i>	conserves whole ecosystem; prevents hunting; protects from humans;	difficult to manage; very expensive;
<i>Convention on International Trade in Endangered Species (CITES)</i>	signed by many countries; protects many species;	difficulty enforcing treaty; many countries have not signed it; implementation varies from country to country;

[6 max]

Allow any other reasonable points.

- (c) Award [1] for name and brief description e.g.  
 Coto Doñana – wetlands and coastal habitats in southern Spain;

*Evaluation:*

provides vital habitat and food for birds migrating between Europe and Africa;  
 also plays an important role in education;  
 provides opportunity for ecological research;

[3]

**Option D – Pollution Management**

- D1.** (a) non-point;  
*Award [1] for explanation, e.g.*  
because involves large area and cannot be traced back to a single, treatable source; **[2]**
- (b) *Award [1] for method and [1] for a brief description e.g.*  
air: air-filter pumps;  
water: collect water – filter – measure pH / chemical analysis;  
soil: collect soil – granulometry (particle size measurement) – determine pesticides;  
biota: measure concentration of pesticides in tissues;  
  
repeat measurements several times and calculate mean;  
repeat measurements different distances from contamination and over a period of time; **[2 max]**
- (c) *Strategies:*  
introduce incentives for alternatives to pesticides / penalties / legislation;  
use of alternative pest controls / biological control;  
setting and imposing standards;  
ban the use of most toxic chemicals (*e.g.* DDT, Dieldrin);  
use of certain pesticides only in specialized circumstances (*e.g.* not entering the food chain);  
compare effectiveness, *i.e.*, rate of beetle infection with different levels of pesticide use and alternative strategies;  
regular monitoring prior and following changes in procedure;  
  
*Evaluation:*  
difficulty in enforcing penalties;  
economic benefits / costs;  
health considerations;  
national / international differences (*e.g.* legislation); **[3 max]**  
  
*Any other reasonable point. Award [2 max] if no evaluation is provided.*
- (d) (i) the potato and tomato have very low residues;  
lettuce has a very high initial concentration of residue (after 3 days);  
amount of pesticide in lettuce after 14 days is low / similar to potato and tomato;  
behaviour of residues varies (in some crops increasing, some decreasing over time);  
residue levels vary from crop to crop; **[3 max]**  
*Any other reasonable suggestion.*
- (ii) all crops provide some risk of contamination;  
lettuce should not be consumed within three days of pesticide application;  
pepper retains high levels of pesticides and probably should not be sprayed;  
*Any other reasonable point.*

- D2.** (a) *Answers will vary with waste type selected.*  
*e.g. radioactive waste from nuclear plants:*  
some sent for reprocessing;  
some buried in abandoned mines;  
*Atmospheric pollutants are not suitable as examples of industrial waste.*

*Evaluation:*

material may have to be stored for very long periods;  
long routes for transport of materials (*e.g.* from Japan to Europe);  
risk of hijacking and terrorism;  
expensive and elaborate handling precautions;  
*Any other reasonable points.*

**[5 max]**

- (b) *Advantages:*  
may save energy;  
may save resources;  
reduces volume of landfill;  
less contamination (as compared to incineration);  
can produce economic return;

**[2 max]**

*Disadvantages:*

needs separate collection systems for different commodities;  
considerable energy may be required in recycling;  
needs space for storage and processing;  
requires large quantity of labour (*sorting, etc.*);  
prices fluctuate greatly;  
cost may be high;  
difficulty of persuading people to recycle as it requires effort;  
not everything can be recycled;

**[2 max]**

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