



MARKSCHEME

May 2007

ENVIRONMENTAL SYSTEMS

Standard Level

Paper 3

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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) (i) the weight/mass of (organic) material, after the removal of water; **[1]**

(ii) *Methodology will vary slightly with ecosystem chosen.*
Award [1] for each of the following up to [4 max]. Award [3 max] if no evaluation of (E) points given.
 mark out measured area;
 select quadrats using an appropriate method;
 harvest all plant material within sample area;
 air dry / oven dry;
Do not accept ‘burn’
 weigh;
 ideally take several samples and obtain mean;
 problems with very large trees / difficult to harvest / destruction of ecosystem (E);
 problems with estimation of subterranean biomass (especially in forest ecosystems) (E);
Any other reasonable point **[4 max]**
Points of methodology inappropriate to selected ecosystem should not be credited.
Reject any discussion of animals / secondary productivity

(iii) *Methodology will depend on abiotic factor chosen and must be appropriate to the selected ecosystem.*
 name of factor (e.g. temperature, rainfall);
Do not accept a biotic factor
 brief methodology (e.g. use thermometer/thermograph/rain gauge);
 repeat observation under similar conditions regularly over period/day/year; **[3]**

(b) (i) area A: $\frac{20 \times 19}{12 + 20 + 42 + 12} = \frac{380}{86} = 4.4$

area B: $\frac{20 \times 19}{0 + 56 + 72 + 2} = \frac{380}{130} = 2.9$

Accept more but not less significant figures than above.

therefore, area A is the most diverse area;

[1] for correct method, [1] for correct answers. Award [1] for identifying area A.
Allow ECF for final point, but no mark if no working shown at all **[3 max]**

(ii) *Award [1] for any reasonable factor e.g.*
 succession;
 soil texture;
 moisture;
 pH of soil;
 logging/burning;
 light intensity; **[1 max]**
Reject a statement about number of species and abundance of species.

- (c) (i) *Award [1] for two of the following and [2] for three*
presence of wings;
presence of pincers;
steeply curved antennae/feelers;
abdomen more than twice the size of head and thorax / relative size of head,
thorax, abdomen;
horn-like structure on head;
absolute size;
Any other reasonable suggestion [2 max]
Reject number of legs. All the specimens shown have six, as do almost all
(adult) insects.

- (ii) *Award [1] for each of the following:*
use field guide / illustrated textbook;
compare with museum specimen;
internet resources, *OWTTE*;
consult expert on the group;
distribution;
DNA testing;
behaviour (including sound);
habitat;
time of day or year;
Any other reasonable points [2 max]

- (iii) *Award [3 max] for method and [1 max] for evaluation.*
methods:
simple numerical count of termite mounds;
sample area might be taken and result multiplied to give total figure;
mean of several samples might be taken;
use aerial photos to count mounds;
(Reject use of satellite images: scale probably too small).
use catch – release – recapture / Lincoln index method to estimate number
of termites in a colony;
multiply estimate of numbers in colony by number of colonies;
evaluation:
problems of dealing with very large numbers;
difficulty of access to interior of termite mound;
problems of variation in numbers with season;
difficulty of estimated numbers outside mound foraging;
Lincoln index method may not be appropriate for termite community if
organisms do not move around randomly between marking and recapture;
problems of recruitment to population and deaths between marking and
recapture; [4 max]
Any other reasonable suggestions for method or evaluation

*When marking be tolerant: reward adequate understanding of methods or
concepts. However, award [3 max] if mounds are not mentioned at all or if
an account focuses solely on mounds to the exclusion of actual insects.*

Option B — Impacts of Resource Exploitation

B1. (a) *Award [1] for each pair of valid advantage and disadvantage up to [4 max].*
advantages

- use very small volume of fuel;
- once constructed, cheap to run;
- can be constructed away from source of coal etc;
- can be a source of other radioactive materials for industry/medicine;
- little/no CO₂ produced;
- can be a source of military plutonium;
- could be considered a disadvantage - do not allow both.*
- causes relatively little atmospheric pollution;
- creates (high level) jobs/employment;

disadvantages

- very expensive to construct;
- problems of decommissioning at end of useful life;
- strict health and safety requirements/risk of leakages, *etc*;
- risk of theft/ hijacking of radioactive materials;
- so civil liberties implications for protection of plant/ fuel;
- problems of disposal of spent fuel/ very long half-life of fuel;
- require large amounts of cooling water;
- require a technically advanced/ educated labour force;

Any other reasonable points

[4 max]

(b) (i) **Western Europe and Australasia;**

Candidates must have both of these, and in the right order for the mark.

[1 max]

(ii)

$$\frac{504 - 40}{40} \times 100;$$

$$= 1160\% ;$$

[2]

(iii) *Four of the following points:*

- output in all regions has steadily increased;
- with increases in population (E);
- and improvements in agricultural technology (E);
- signs of slow-down in rate of increase in Africa;
- and actual reversal in Europe;
- because of overproduction / set-aside (E);
- because of pollution / eutrophication (E);
- consumption in Europe much higher than Australasia / Africa;
- because of large area of arid/semi-arid land unsuitable for agriculture (E);
- because of lower level of technology / subsistence agriculture in Africa (E);
- high subsidies for fertiliser in Australia and Europe (E);

[4 max]

Any other reasonable suggestions

Must have at least one “explain” point for [4 max].

- (c) Award [1] for each of the following.
increase in crop production;
increase in N loss through soil leaching;
increase in loss of heat (through use of fuel in spreading, increased growth);
increase in CO₂ production (through use of fuel in spreading);
Any other reasonable suggestions [2 max]
Reject increase in farm income as this is an input.
Reject 'pollution' (too vague).
- (d) (i) the area of land / land and water required;
to (sustainably) support a defined human population (at a given standard of
living) (*glossary*). *OWTTE*; [2]
- (ii) Award [1] for each of the following.
footprint of DC commercial farmer will be much larger;
will use more chemicals;
which will need a larger area to absorb;
will use more fossil fuels / energy subsidy;
and so produce more CO₂;
which will need a larger area to absorb;
DC farmer will use more water for irrigation *etc.*;
Any other reasonable point [5 max]
*Converse statements equally acceptable e.g. "footprints of LDC farmer will
be much smaller" or "LDC subsistence farmer will use less chemicals", but
same point cannot be rewarded twice.*

Option C — Conservation and Biodiversity

- C1.** (a) (i) genetic diversity represents the range of genetic material / variability in a gene pool/population;
whereas habitat diversity represents the range of different habitats / ecological niches in an ecosystem or biome (*based on glossary*); **[2 max]**
- (ii) diversity at initial stage is low;
species diversity increases with colonisation through pioneer stages and later stages of succession;
as plants grow, habitat diversity increases;
as habitat diversity increases, species diversity increases;
as productivity increases;
and food chains lengthen and insects and vertebrates colonise;
so a positive feedback link exists between habitat and species diversity;
rise in populations and immigration may increase genetic diversity;
Any other reasonable point **[4 max]**
- (iii) islands represent isolated ecosystems;
and therefore support isolated populations;
immigration/incoming gene-flow is rare;
population of goats likely to be based on a small original or “founder” population;
with very small genetic variety;
mixing of limited gene pool may have led to common intermediate characteristics;
limited gene pool may have resulted in a population which was very similar/homogenous;
natural selection;
may have caused adaptation;
to the characteristics of the island environment (*e.g. camouflage*); **[3 max]**
Any other reasonable point
- (iv) the higher the area of the reserve, the higher the population;
the higher the population the higher the genetic index;
with one slight exception (Addo);
because a large population can generally “hold” a greater variety of genes / variation than a small one;
the density of population varies from 6 ha per animal to over 200 ha per animal;
the density may vary with habitat/vegetation/climate;
might reflect difference in wildlife management/conservation/hunting;
Any other reasonable point **[5 max]**

- (v) small, isolated populations contain a very limited range of genes;
and therefore cannot vary or evolve very much;
this increases the possibility that they will become extinct;
a larger area can contain larger, and therefore more stable population;
other factors include the greater habitat and species diversity that can be held in larger areas;
however, some argue that a number of small reserves are preferable to a few large ones;
as the package of genes / habitats / species will be different;
and if one reserve is destroyed, others may survive; **[2 max]**
Any other reasonable points
Be tolerant, reward understanding of ecological and conservation principles.

- (b) *Award [1] for each factor plus example.*
volcanic eruption (e.g. Mount St Helens / Krakatoa);
glaciations (quaternary ice advances in northwest Europe);
meteorite impact (mesozoic impact in the Americas held by some to be responsible for a major extinction event);
deforestation (northwest highlands of Scotland: “The Great Wood of Caledon”);
monoculture (West Australian wheat belt / North American prairies);
introduction/escape of non-native species (New Zealand);
pollution (River Thames / reduction of predators through use of pesticides in 1960s);
over-hunting/collecting (extinction of passenger pigeon in North America / thyracine in Tasmania);
Any other reasonable suggestion **[4 max]**
When marking be tolerant. Give benefit of the doubt to any apparently reasonable examples.
Allow [2 max] for appropriate factors but without named examples.

Option D — Pollution Management

- D1.** (a) *Award [1 max] if candidate has first point and one or other of the other two.*
pollution = the addition to an environment of a substance or agent (such as heat) by human activity;
at a rate greater than that at which it can be rendered harmless by the environment;
and that has an appreciable effect on the organisms within it *OWTTE*. (*Glossary*); **[1 max]**
- (b) (i) **Biochemical Oxygen Demand/Deficit;**
a measure of the amount of dissolved oxygen required to break down the organic material in a given volume of water (through biological activity) *OWTTE*. (*Based on Glossary*); **[2 max]**
- (ii) *describe:*
BOD increases downstream, apart from point 5;
bacteria count increases downstream apart from point 5;
thus BOD increases with bacteria count/rate of increase of BOD is approx in proportion to bacterial count;
explain:
organic matter in sewage/animal waste/food processing residues/ elevates BOD;
more and more sewage is put into river downstream;
tributaries bring in additional effluent;
point 5 might be close to mouth, so dilution possible;
organic matter may have decomposed by this point; **[5 max]**
Any other reasonable suggestions
Award [3 max] for description alone.
- (iii) *Award [1] for each of the following.*
eutrophication;
higher turbidity;
higher N content;
higher P content;
smell / odour;
temperature;
pH;
fewer fish / water plants / aquatic insects;
presence of species adapted to extreme eutrophic conditions (*e.g.* bloodworms, algae, fungi); **[4 max]**
Any other reasonable points
Do not reward high BOD or high bacteria count.

- (c) *Response will of course depend on industrial waste selected.*

Suggested points for an answer for radioactive waste disposal

half-life of radioactive materials is many thousands of years;
so very long-term management is necessary;
special precautions/guards/secrecy for transport by land/sea;
air transport may be unsuitable;
might be preserved in artificial rock/glass;
could be expensive for large quantities (E);
deep burial possible;
must be tectonically very stable area (E);
submerge in capsules in deep ocean;
eventually might contaminate hydrosphere (E);
used in past and still discussed but contrary to several international agreements
(e.g. Art 210 of UN Law of Sea Convention, 1982, and Protocol on Marine
dumping of Wastes, 1996) (E);
shallow burial in monitored sites;
possibility of seepage (E);
and strong local opposition (E);

[5 max]

Must have at least one "Evaluation" (E) point for [5 max].

- (d) *Allow any reasonable suggestion, but look for some detail. "Change lifestyle" is insufficient e.g.*

switch to less polluting fertilisers;
granulated rather than powdered fertilisers (slow release);
biological control rather than pesticides;
encourage/subsidise public transport rather than use of private cars;
congestion charge (e.g. central London);
encourage/subsidise insulation of homes rather than fuel consumption;
encourage recycling;
fit catalytic converters to vehicles;
reduce intensity of air conditioning (said to be a requirement in Hong Kong that
this is not set below 25.5 °C);

[3 max]
