



MARKSCHEME

May 2008

ENVIRONMENTAL SYSTEMS

Standard Level

Paper 2

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Subject Details: Environmental Systems SL Paper 2 Markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in Section A [**30 marks**] and **ONE** question in Section B [**20 marks**]. Maximum total = [**50 marks**]

1. A markscheme often has more marking points than the total allows. This is intentional. Do **not** award more than the maximum marks allowed for part of a question.
2. Each marking point has a separate line and the end is signified by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/) - either wording can be accepted.
4. Words in brackets () in the markscheme are not necessary to gain the mark.
5. Words that are underlined are essential for the mark.
6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by writing **OWTTE** (or words to that effect).
8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
9. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. Indicate this with **ECF** (error carried forward).
10. Only consider units at the end of a calculation. Unless directed otherwise in the mark scheme, unit errors should only be penalized once in the paper. Indicate this by writing **-1(U)** at the first point it occurs and **U** on the cover page.

SECTION A

1. (a) long-term trend of an apparent rise in sea-level;
 approx 12 cm (\pm 3 cm) rise in about 90 years;
 possibly due to greenhouse effect / increase in greenhouse gases in atmosphere
 (CO₂, CFCs, *etc.*) / global warming; (E)
 greenhouse gases trap heat/impede outgoing radiation; (E)
 causing rise in mean temperatures; (E)
 and thermal expansion of water of oceans / melting of ice (on land); (E)
 alternatively might be due to subsidence of island / collapse of volcanic island
 material into exhausted magma chamber;
 tectonic movements of sea-floor; (E)
 short-term fluctuations also occur;
 but over too long a time scale to be seasonal;
 approx 5-6 cm on either side of trend;
 possibly due to shifts in ocean currents/tidal phenomena/El Niño-like phenomena;
 (E)
 possibility of errors of measurement; (E)
 particularly for older records; (E)
 relatively stable period in 1950s;

Any other reasonable point.

Descriptions of the graph [3 max]

Appropriate explain (E) points [3 max]

[6 max]

- (b) Lowest: 1909 (*allow 1908-1910*) **and** Highest: 1980; (*allow 1979-1981*)

[1]

- (c) phosphates in water absorbed by phytoplankton;
 phytoplankton consumed by zooplankton/small fish;
 small fish consumed by larger/carnivorous fish;
 fish consumed by seabirds (*e.g.* gulls, terns, albatross, boobies, gannets,
 cormorants *etc.*);
 seabirds commonly nest on oceanic islands;
 phosphates excreted by young and adult birds (guano);
 and leached into soil;
 or direct splashing of seawater onto soil / blowing of sea-spray by wind;
 sea water/organic debris carried onto shore by high tide;

Any other reasonable suggestion.

Accept in form of diagram.

Must have at least three of the above for

[3 max]

- (d) open because it exchanges both matter and energy with its surroundings OWTTE;
*Must have both "open" **and** the explanation for mark.*

[1]

2. *Should have name (toponym), or sufficient detail for the site to be identified. No separate mark for this, but response must be consistent with ecosystem named.*

Example: Chalk grassland with scattered shrubs, Fleam Dyke, Cambridgeshire, UK
 Mangrove swamp, (near Derby, Western Australia)
 Oakwood, (Wytham, Oxfordshire, UK)
 Conifer forest with thick understorey, (Vancouver Island, Canada)
 Open savanna with Acacia trees, (Kruger National Park, South Africa)
 Coral lagoon, (Cocos Islands, Indian Ocean)

- (a) *Examples of each category must correspond to named ecosystem. Names must be specific: 'bird' or 'tree' is unacceptable. Common or scientific names are acceptable.*

Example (for Wytham Wood):

Producer: Oak tree

Herbivore: Wood mouse

Carnivore: Tawny owl

Decomposer: Bracket fungus on dead wood.

[1 mark] for each pair; if one given, [0 marks]; if 3 given, [1 mark] [2 max]

- (b) *One of the organisms named in (a) must be given. No separate mark for the name, but allow ECF in this section if inappropriate organisms named in (a).*

Example: wood mouse.

- (i) *Abiotic factor:*

rainfall;

heavy rain may flood burrows and disrupt breeding; reducing population;

[2]

- (ii) *Biotic factor:*

numbers of tawny owls;

heavy predation by owls will reduce wood mouse numbers;

competition between wood mice for food;

if food is short, weaker mice starve, reducing population;

[2 max]

Must have name of factor [1] and brief explanation [1] in each case for full marks.

3. Succession = orderly process of change over time in an ecosystem/a community changing the abiotic environment such that other communities can become established;
Zonation = the arrangement or patterning of plant communities into parallel or sub-parallel bands;
in response to an environmental factor over a distance/across an environmental gradient;
(Definitions based on Glossary)

While candidates are not expected to give these definitions verbatim, they should be given credit for showing a clear understanding of the concepts and the differences between them.

in succession, a community develops in a new/recently disturbed area;
in succession energy flow increases as succession progresses;
complexity increases as succession progresses;
succession involves changes in communities through time;
communities move through pioneer/seral/climax stages over time;
nutrient turnover increases as succession progresses;
often no change in these across zonation;
zonation occurs because of different tolerance ranges of organisms;
zonation involves changes in communities across a distance;
due to patterns in the distribution of abiotic factors;

example of succession – colonisation of sand dunes, West Australian coast;
bare sand → Spinifex → Olearia scrub → Acacia thicket → Eucalypt forest;

example of zonation – altitudinal zonation in Alps;
deciduous forest and meadow – conifer forest – Alpine grassland – snowfield;

Any other reasonable points.

Reward environmental and ecological awareness.

[4 max] if no examples

For full credit, at least one point and one example must relate to both succession and zonation.

[6 max]

4. (a) the maximum number of individuals of a species or the “load” that can be sustainably supported by an environment or habitat / *OWTTE* (Based on glossary); *Both the concept of maximum number and of sustainability must be included for credit.*

[1]

- (b) (i) rapid, steady increase in numbers for first 60 days, from close to zero to 2500 because numbers are below carrying capacity;
 food/space, *etc.* not limiting in early stages;
 numbers approx constant (vary from 2500 to 3000) for second half of culture as carrying capacity is reached;
 food supply/area/volume/build-up of toxins will not support larger number in second half of experiment;
 small fluctuations may be due to appearance of different generations/
 environmental conditions/or random;
 negative feedback may be occurring periodically in second half of the experiment;
 maintaining the population at a relatively steady equilibrium;
Any other reasonable suggestions.

Award marks only for explanations, not for descriptions of graph.

[4 max]

- (ii) slight variations may continue for some time if food supply sufficient;
 gentle decline as food is progressively exhausted;
 and toxins build up;
 sudden “crash”/collapse possible at point when breeding no longer possible;
Any other reasonable suggestions.
Predictions must have some explanation for credit e.g. “decline in population” without further comment is insufficient. Accept either one prediction with two explanations or two predictions each with an explanation for

[2 max]

SECTION B

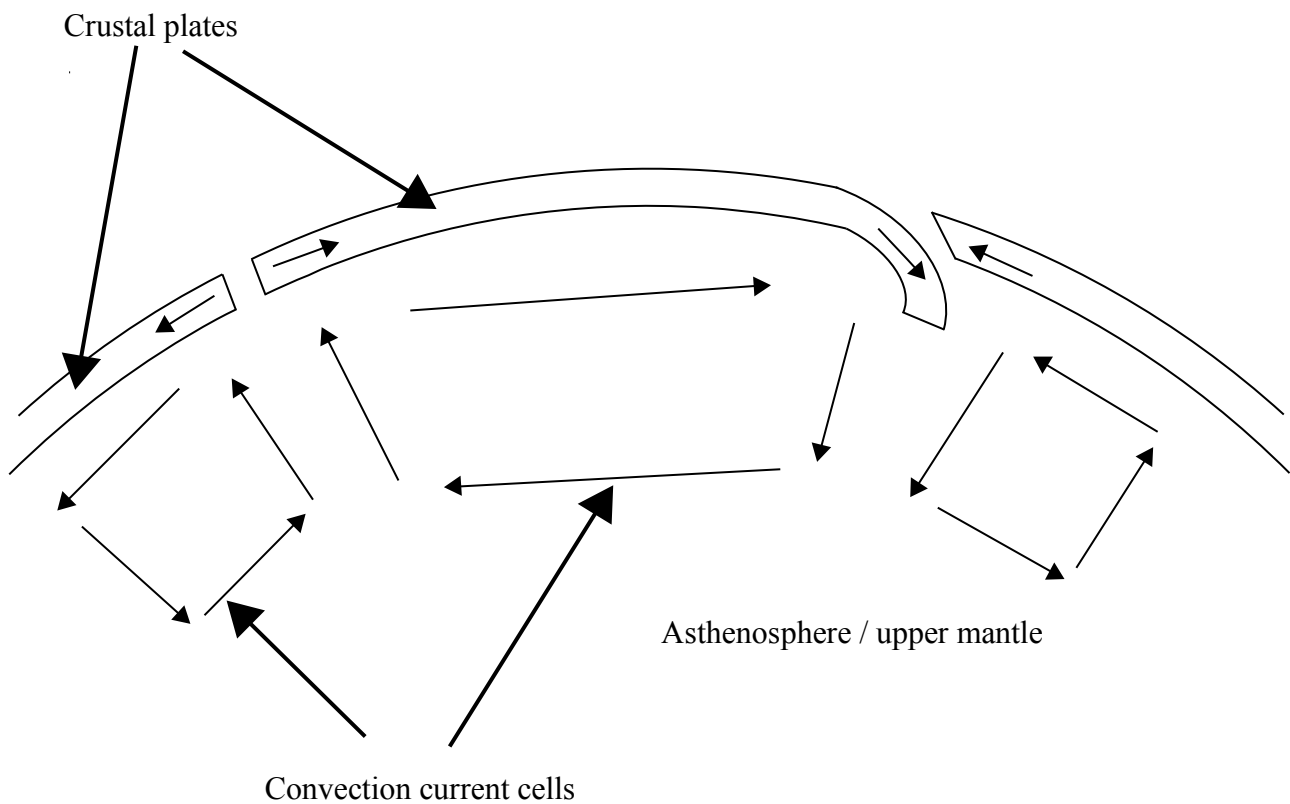
General Essay Markscheme

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 or ecological concepts, and good examples even if not stated exactly in the form given in the markscheme.

5. (a)

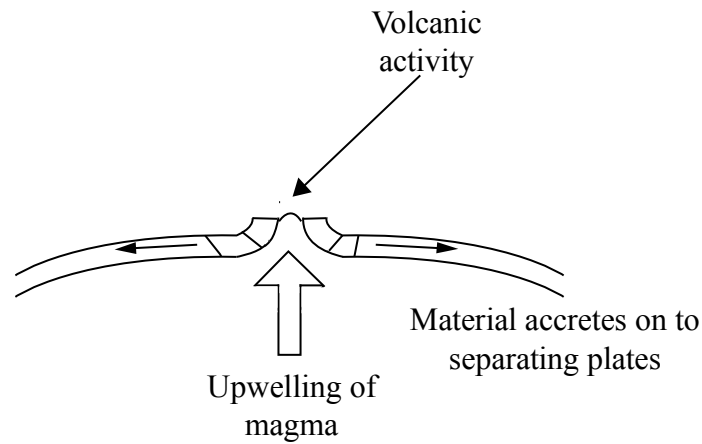


Allow: **[1 mark]** for diagram showing asthenosphere/(upper) mantle and crustal plates in approximately correct proportional thickness;
[1 mark] for at least one correct convectonal cell and no incorrect ones;
[1 mark] for correct movement of at least one pair of plates and no incorrect ones; **[3 max]**
 Award no credit if candidate has not included a diagram – question clearly states “draw a diagram”.

(b) *Constructive margin*

clear diagram showing two plates moving away from each other;
material rising into gap between plates/volcanic activity/other relevant feature;

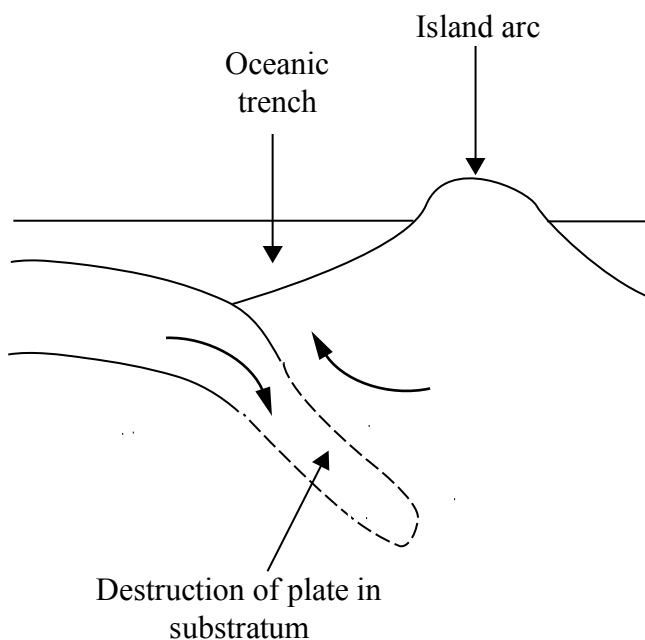
[2max]



Destructive margin

clear diagram showing one plate diving directly beneath another plate/island arc;
oceanic trench/destruction of subducted plate/associated volcanic activity/other relevant feature identified;

[2max]



(Continued on the following page)

(Continued from previous page)

Discussion must have at least one point from each of the following two groups for [3 max].

Credit any points listed below which are shown on diagrams, provided they have not already been credited above.

Constructive margins:

constructive margins = zones where plates are moving apart;
due to transverse/sideways/lateral movement of molten/semi-molten rock material under crust;

material from below accretes/sticks/adheres onto separating plates;
may be associated with (present-day or geologically recent) volcanic activity;

e.g. Iceland/Ascension/Azores/Tristan da Cunha in Atlantic;

or may be marked by rift valley;

e.g. Red Sea/East African Rift;

Destructive margins:

destructive margins = zones where plates are colliding;

one plate dives beneath another / subduction;

producing ocean troughs/deeps;

e.g. Marianas Trench;

oceanic plate subducted beneath less dense continental plate;

may be associated with earthquake zones (on or offshore) / volcanic activity on continental plate;

in oceans, may give rise to island arcs;

e.g. New Zealand/Japan;

[7 max]

- (c) formation of barriers such as oceans/mountains/rift valleys;
separation of gene-pools;
leading to speciation;
isolation of biota;
e.g. distinctive flora and fauna of Australia (eucalypts, monotremes, marsupials)/
Madagascar (lemurs);
formation of land bridges allowing movement between previously separated
plates;
e.g. East Indies (spread of Australian species into Islands)/Bering Strait (reindeer
and caribou very similar);
movement of plates through different climatic zones;
causes new habitats to be presented / changing factors affecting natural selection;
and new forms to evolve to inhabit them;
e.g. northward movement of Australian plate and “drying” of much of the
continent (evolution of aridity-tolerant flora);
formation of islands along plate margins;
e.g. Iceland / island arcs of Pacific;
provides new, isolated habitats;
and development of biota with high degree of endemism/ many unique forms;
volcanic activity/plate destruction may lead to destruction of ecosystems/loss of
diversity;

Any other reasonable points/relevant examples.

Award [5 max] if no examples included.

Must have at least two examples for

[7 max]

Expression of ideas [3 max]

6. (a) sandy soils contain a high proportion of sand/relatively large particles whereas loam soils contain a balance of sand, silt and clay particles;
sandy soils often contain quartz particles whereas loam contains some clay minerals (*e.g. kaolinite*);
sandy soils have relatively larger air spaces than loam soils;
sandy soils drain more freely than loam soils / loam soils tend to retain water more than sandy soils;
sandy soils are often more infertile than loam soils / cannot retain nutrients;
loam soils often contain more organic matter;
loam soils have richer microflora and fauna;
sandy soils have lower capillarity than loam soils;

Any other reasonable suggestions.

Credit responses given in the converse (e.g. loam soils have higher capillarity than sandy soils), but do not credit both a statement and its converse.

Award [4 max] if no explicit comparison (e.g. where candidates simply describe one soil and then the other). Allow full marks for tabulation if done well. Reward relevant soil diagrams such as triangular diagrams. [5 max]

- (b) *Degradation: [2 max]*
overgrazing leaves soil bare;
deforestation leaves soil bare;
monoculture/other poor cultivation practices leave soil denatured;
and exposed to erosion;
excess irrigation causes build-up of salt in soil/salinisation;
desertification is often a combination of the above;
compaction by heavy machinery/animal or human trampling destroys soil structure;
preventing water draining through soil;
leading to increased surface runoff/soil erosion;

Evaluation of remedial measures: [4 max]

reducing stock levels – may lead to reduction of income;
reducing deforestation/clear-cutting – may lead to reduction of income;
planting of wind-breaks/shelter belts may involve considerable expense;
pay back time for some remedial measures may be long;
cultivation techniques such as contour plowing/minimum plowing reduce erosion at little extra cost;
preventing plowing in marginal lands preserves thin/fragile soils;
use of remedial measures may be limited by lack of expertise (especially in LEDCs);
where a population is growing rapidly, remedial measures may be difficult to initiate;
many small land holdings may make large scale changes hard to implement;
reduced use of machinery may reduce yields/increase labour costs;

Any other reasonable points.

Although measures should be identified, marks should be awarded only for their evaluation, not simply their identification.

[6 max]

(c) *Impacts: [2 max]*

pH of soil becomes too low for plant growth (unless soil has some buffering capacity);
release of toxic ions;
e.g. aluminium;
release and leaching of nutrients;
e.g. magnesium/calcium;
increase in ecosystem fertility from deposition of nitrates, may change community structure/reduce biodiversity;

Strategies and evaluation: [4 max]

reducing use of fossil fuels / using alternative energy sources reduces acid gases; but alternative technology expensive (*candidates may offer a variety of examples of alternative technology, etc. but credit should only be given for their evaluation*);

catalytic converters (CATs) effective for reducing NO_x in transport; but often too expensive to install in LEDCs;
CATs still emit SO_x;
unless used with low sulfur fuel;
mining of precious metals used in CATs causes environmental damage;

liming raises pH of soil;
but may change type/abundance of organisms living in the ecosystem limed;
lime must be quarried, causing damage to other environments;
scrubbers in smoke stacks to remove sulfur very costly to install in power stations;
international agreements to reduce emissions can be effective in MEDCs;
but LEDCs often can't afford alternatives;
and often difficult to enforce;
because source may be distant from impact, it may be difficult to identify;
e.g. pollutants from northern England may affect Scandinavia;

Any other reasonable points.

Although strategies should be identified, marks should be awarded only for their evaluation, not simply their identification.

[6 max]

Expression of ideas [3 max]

7. (a) *Requirements for photosynthesis/inputs:*
presence of green plants;
containing chlorophyll;
appropriate temperature (usually 0–40°C);
light energy;
of suitable wavelengths;
carbon dioxide;
water;

Outputs:
oxygen;
organic matter/sugars/carbohydrates;
heat;
stored (chemical) energy/ATP;

A diagram is an acceptable alternative to a description or as an addition to a description.

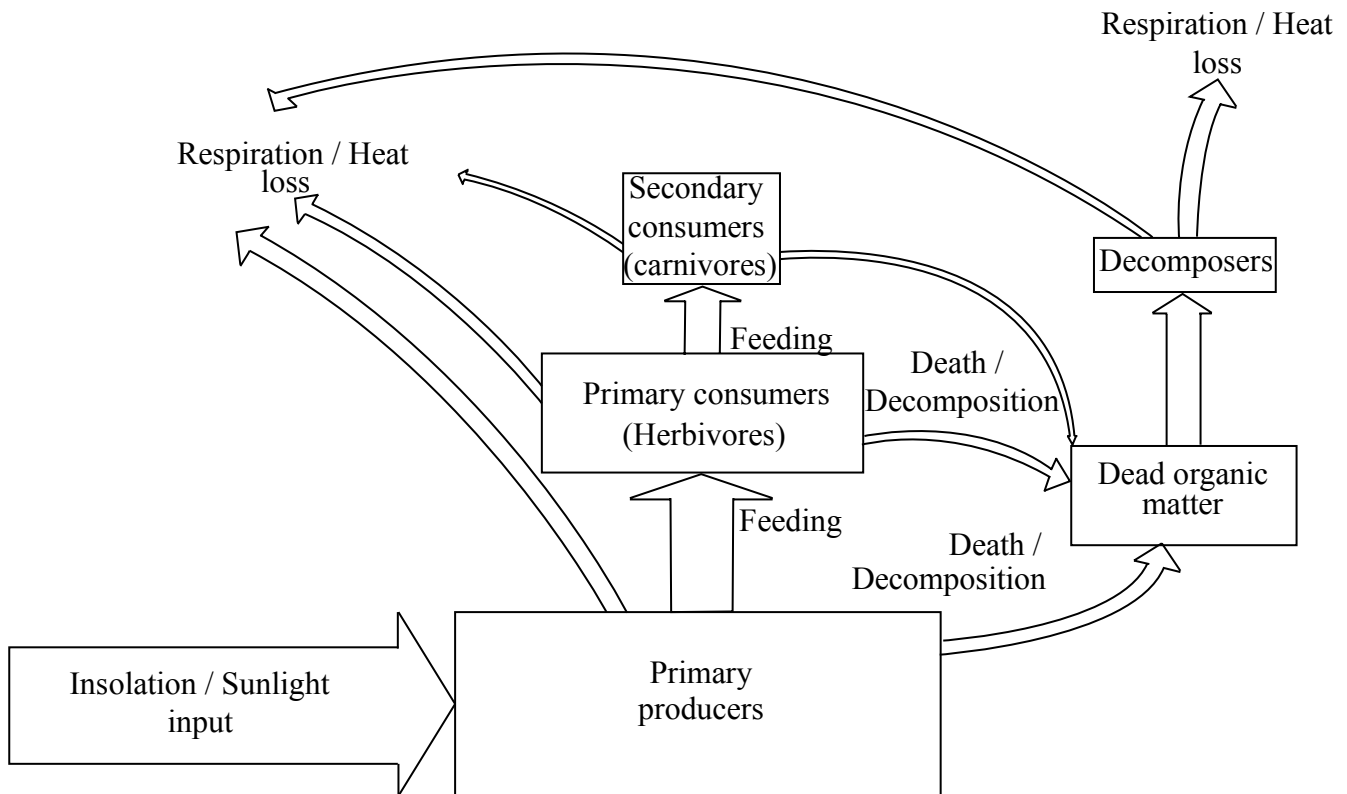
Allow [1] for each two correct points from lists above

[5 max]

- (b) gross primary productivity is the total amount of organic material produced / solar energy/carbon fixed by (green) plants/producers;
per unit area per unit time;
energy stored in the organic matter is released through respiration;
to provide the plant with energy for active/metabolic processes;
net primary productivity is the remaining gain in biomass/energy after this respiration/ $NPP = GPP - R$;
NPP is the productivity/energy available to herbivores/next trophic level;

[4 max]

(c)



For quality of diagram: [2 max]

neat, clear diagram, using boxes for storages and arrows for flows;
reduction in size of storages/flows, at higher trophic levels, shown by reducing size of boxes/arrows;

Award [6 max] for correct labeling as follows:

Award [1] for each pair of correct storages from list below: [2 max]

Storages:

primary producers;
primary consumers/herbivores;
secondary consumers/carnivores;
dead organic matter/decomposers;

Award [1] for each correctly labeled flow, shown in correct direction (credit each label only once): [4 max]

insolation;
feeding;
respiration/heat loss;
death/decomposition;

[8 max]

Question clearly asks for a diagram; allow no credit for a written explanation.

Expression of ideas [3 max]