



# **MARKSCHEME**

**November 2009**

## **ENVIRONMENTAL SYSTEMS**

**Standard Level**

**Paper 2**

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## General Marking Instructions

*Assistant Examiners (AEs) will be contacted by their team leader (TL) by email (or telephone) – if by e-mail, please reply to confirm that you have downloaded the markscheme from IBIS. The purpose of this initial contact is to allow AEs to raise any queries they have regarding the markscheme and its interpretation. AEs should contact their team leader by e-mail at any time if they have any problems/queries during the marking process.*

### Note:

The DHL courier service must be used to send assessment material to your team leader/senior moderator and to IB Cardiff. (However, this service is not available in every country.) The cost is met directly by the IB. It is vitally important that the correct DHL account number is used.

If you have any queries on **administration** please contact:

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1. Follow the markscheme provided, award only whole marks and mark only in **RED**.
2. Where a mark is awarded, a tick/check (✓) **must** be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark. **One tick to be shown for each mark awarded.**
3. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases write a brief annotation to explain your decision. You are encouraged to write comments where it helps clarity, especially for moderation and re-marking. It should be remembered that the script may be returned to the candidate.
4. Unexplained symbols or personal codes/notations are unacceptable.
5. Record marks in the right-hand margin. For section A this should be against each mark allocation shown in square brackets *e.g.* [2]. The total mark for a question must equal the number of ticks for the question.
6. Do **not** circle sub-totals. **Circle the total mark** for the question in the right-hand margin **at the end of the question.**
7. Where an answer to a part question is worth no marks, put a zero in the right-hand margin next to the square bracket.
8. Where work for section A is submitted on additional sheets the marks awarded should be shown as ticks and a note made to show that these marks have been transferred to the appropriate square bracket in the body of the script.
9. Section A: Add together the total for each question and write it in the Examiner column on the front cover.  
Section B: Insert the total for each question in the Examiner column on the front cover.  
Total: Add up the marks awarded and enter this in the box marked TOTAL in the Examiner column on the cover sheet.
10. After entering the marks on the front cover 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. **All scripts are checked and a note of all clerical errors will be given in feedback to examiners.**
11. If an answer extends over more than one page and no marks have been awarded on a section draw a diagonal line through that section to indicate that it has been marked.
12. If a candidate has attempted more than the required number of questions within a paper or section of a paper, mark all the answers and use the marks of those answers that have the highest mark, **unless the candidate has indicated the question(s) to be marked on the front cover.**
13. A mark should not be awarded where there is contradiction within an answer. Make a comment to this effect in the left hand margin.

## 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 markscheme, 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) a community of organisms;  
and the physical environment they inhabit;  
(Glossary) [2]  
*Must have concept of organisms + physical/chemical environment **or** biotic + abiotic for full marks.*
- (b) a shark is usually the top carnivore in a marine ecosystem / herrings are in a much lower trophic level;  
because energy is lost at each transfer between trophic levels;  
there is relatively little food per unit area for carnivores such as sharks / herrings can extract their food from a smaller area; [2 max]  
*Any other reasonable suggestion.*
- (c) (i) 1949–1953 number fairly high / 290–380 killed per year;  
very sharp fall/crash in 1953;  
thereafter numbers low / less than about 60 per year;  
with minor fluctuations in numbers after 1954; [3 max]
- (ii) abrupt fall between 1953 and 1954 may be due to reduction in population of rabbits due to disease (*e.g.* Myxomatosis);  
might be due to change in shooting strategy due to economic factors/price of meat/fur;  
later fluctuations may be due to occasional build-up of numbers then reduction as disease reduces numbers/negative feedback;  
both rabbits and hares are ground-living herbivores so there is some competition for food between them;  
so abrupt fall in number of rabbits releases food resources for hares;  
as shown by increase in the number of hares after 1953;  
shooters respond enthusiastically to a new resource; [4 max]  
*Any other reasonable suggestion.*  
*Award answers that “explain”, reject mere description of graph.*
2. (a) (i) open [1]
- (ii) it exchanges matter (water) and energy with its environment/surrounding systems / there are inputs and outputs of matter and energy [1]
- (iii) 1000000 cubic metres per annum /  $10^6 \text{ m}^3 \text{ yr}^{-1}$  /  $1 \times 10^6 \text{ m}^3 \text{ yr}^{-1}$  [1]
- (b) replenishable;  
the freshwater in this system is non-living, but is recycled by natural energy flows in the atmosphere (*OWTTE*); [2]
- (c) the system would become unsustainable;  
with more being taken from the system than natural processes supply; [2]

3. (a) *Describe:*

pyramid is bimodal/has two peaks;  
broad base (0–15 years);  
“half-way up” (35–50 years);  
narrow area between (20–35 years);  
more males than females in some age groups (*e.g.* 5–20 years);  
more females than males in others (*e.g.* 40–45 / over 70);  
lower part of pyramid straight-sided / slight tapering toward base;  
pyramid tapers toward top;

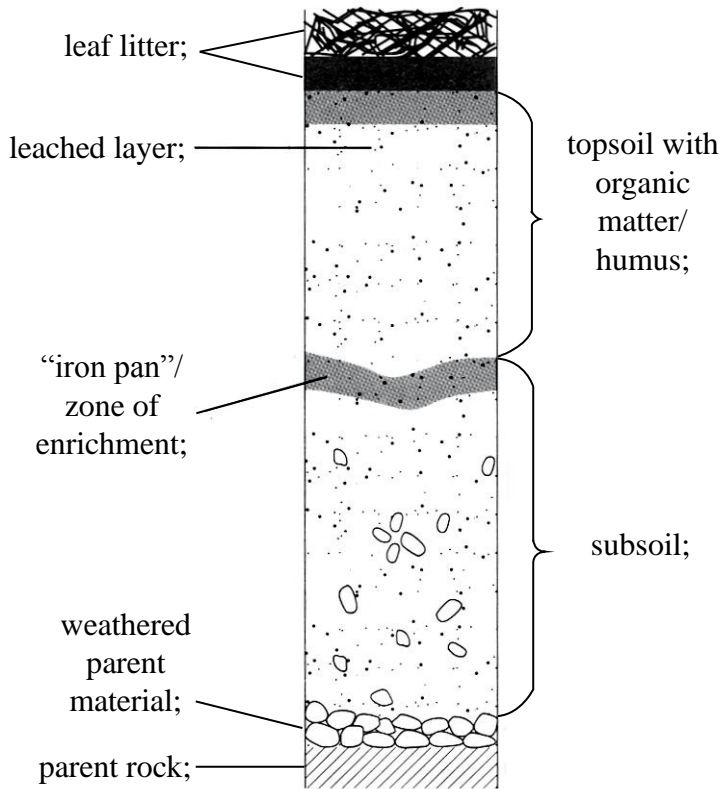
*Explain:*

upper part of pyramid is more characteristic of LDC / lower part DC;  
suggesting transition from LDC to DC;  
straight-sided/tapering base caused by recent reduction in birth rate;  
through rise in standard of living / use of contraceptive methods / improvement in education of women;  
steep tapering of upper pyramid often characteristic of LDC with higher death rates;  
“waist” of pyramid due to reduction in birth rate 25–30 years previously;  
due to economic depression or war;  
(*N.B. Spanish Civil War 1936–1939 -- candidates not expected to know this but allow credit if they do.*)  
loss of males in some age groups due to emigration/war casualties;  
predominance of males/under-representation of females in some age groups possibly due to small sample size;  
preponderance of females in higher age-groups due to higher expectation of life; [5 max]  
*Any other reasonable points.*

*Must have at least two “Explain” points for full marks.*

(b) food and other materials needed can be imported from elsewhere;  
wide variation in lifestyles between areas/countries;  
effects of technology in solving resource issues; [2 max]  
*Any other reasonable points.*

4. (a) Allow any reasonable soil profile diagram. The sketch below is of a podzol.



[Source: adapted from Adds, Larkcom and Miller, *The Organism and the Environment*, second edition, Nelson, (1997), page 65]

At least three identified soil horizons in the correct position:

*e.g.*

- leaf litter;
- topsoil with organic matter/humus;
- leached layer;
- “iron pan”/zone of enrichment;
- subsoil;
- weathered parent material;
- parent rock;

[3 max]

Soil horizons identified will depend on soil type selected.

Allow conventional pedological abbreviations such as horizon O, horizon A, horizon B etc., provided they are in correct positions

- (b) decomposition;
- weathering;
- hydration;
- oxidation;
- reduction;
- nitrogen fixation;

[2 max]



### SECTION B

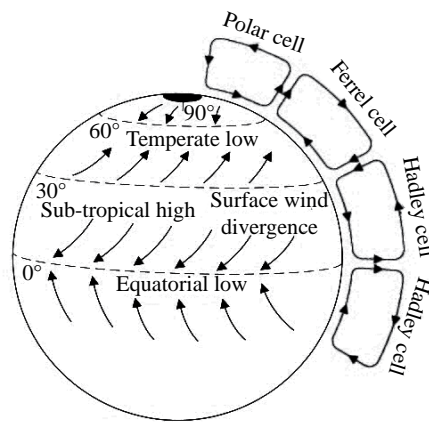
#### General Essay Markscheme

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)



[Source: adapted from K Byrne, *Environmental Science*, Nelson, (1997), page 24]

Allow a segment or "hemisphere" diagram.  
 Three cells accurately shown and labelled, with arrows in the right direction for [3 max].  
 Overall clarity of diagram [1].  
 Allow [4 max] for diagram.

- energy input at maximum at equator (ITCZ);
  - energy deficit at poles;
  - flows of air tend to reduce gradient;
  - vertical movement due to differences in air's density;
  - system modified by Earth's rotation;
  - strong seasonal effects;
  - in Hadley cell less dense / warm air rises in Tropics;
  - causes convective precipitation;
  - movement poleward at high latitude;
  - descending air/high pressure at 30° N and S;
  - unidirectional trade winds at low latitudes;
  - Ferrel cell in middle latitudes is weaker;
  - air rises at about 60° N and S;
  - middle latitude winds are predominantly westerly;
  - especially in southern hemisphere;
  - high pressure air masses in Arctic and Antarctic due to descending cold air;
- Any other reasonable points. [9 max]  
 Any five of above for [5 max].

- (b) descending air from Hadley cell occurs at 30° N and S, moisture has been expelled so air is dry;  
areas at 30° in heart of continents, aridity is intensified by remoteness from oceanic moisture sources;  
*e.g.* inland Australia, Central Asia, parts of Middle East;  
trade winds tend to blow outwards on the western side of continents;  
air above cold ocean currents is cool and so contains less moisture;  
*e.g.* Benguela, Humboldt currents at this latitude;  
*Reward examples only when accompanied by appropriate explanation.*

**[3 max]**

- (c) low rainfall totals limit photosynthesis;  
high temperatures producing high evaporation rates;  
above two factors combine to make for a moisture deficit in desert regions;  
so although light intensity is high, photosynthesis is very low;  
and therefore primary productivity is very low;  
secondary and tertiary productivity is consequently low;  
as in the absence of plant material, herbivores and carnivores are also low in number;  
*Any other reasonable points.*

**[5 max]**

*Expression of ideas [3 max]*

6. (a) zonation is the arrangement of community in parallel or sub-parallel bands or zones;  
in response to an environmental gradient;  
succession is the orderly process of community change over time; [3]  
*Candidates must emphasize that zonation refers to patterns in space, and succession refers to change over time for full marks.*
- (b) climax is the community of organisms at end-point of many ecological successions;  
such a community is more-or-less stable;  
and is in equilibrium with environmental conditions;

*Abiotic factors that influence the nature of a climax include:*

temperature;  
light/day length;  
precipitation;  
edaphic/soil factors;  
soil pH;  
soil texture;

*[5 max]*

*Allow a maximum of two points from this list.*

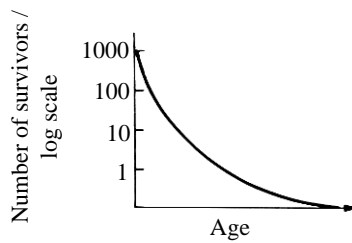
*Any other reasonable points.*

*Do not allow credit for biotic factors.*

- (c) survivorship curve = a graph relating the number/proportion of a cohort of organisms recruited to a population at the same time, against time; shows life expectancy of a population; survivorship curves reflect different ecological/reproductive strategies; adapting them to different environments/different ecological niches;

*pioneer communities:*

- dynamically changing;
- rapid conversion of inorganic matter to biomass;
- rapid growth in numbers;
- high rate of reproduction;
- low level of parental care;
- r*-strategists;
- produces survivorship curve such as (diagram below);



[Source: A Cadogan & G Best, *Environment & Ecology*, Blackie, (1992), page 48]

- exponential decline;
- e.g.* Birch trees and Willow herb/Fireweed in Northern Hemisphere woodland successions;

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*climax communities:*

stability;

slower rate of growth;

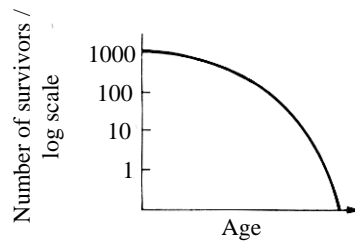
slower rate of reproduction;

higher level of parental care;

often longer-lived;

*K*-strategists;

produces survivorship curve such as (diagram below);



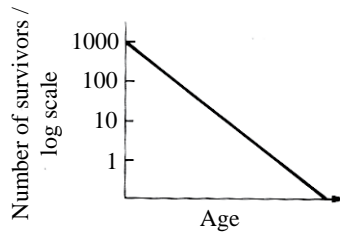
[Source: A Cadogan & G Best, *Environment & Ecology*, Blackie, (1992), page 48]

curve initially gentle decline then steepens;

*e.g.* Mammals and birds;

intermediate forms exist between *r* and *K*;

produces survivorship curve such as (diagram below), *etc.*;



[Source: A Cadogan & G Best, *Environment & Ecology*, Blackie, (1992), page 48]

straight line with negative gradient (with logarithmic scale);

[9 max]

*Any other relevant points.*

*Award [4 max] for up to two sketch graphs (one for correct shape of curve, one for correct labelling of axes).*

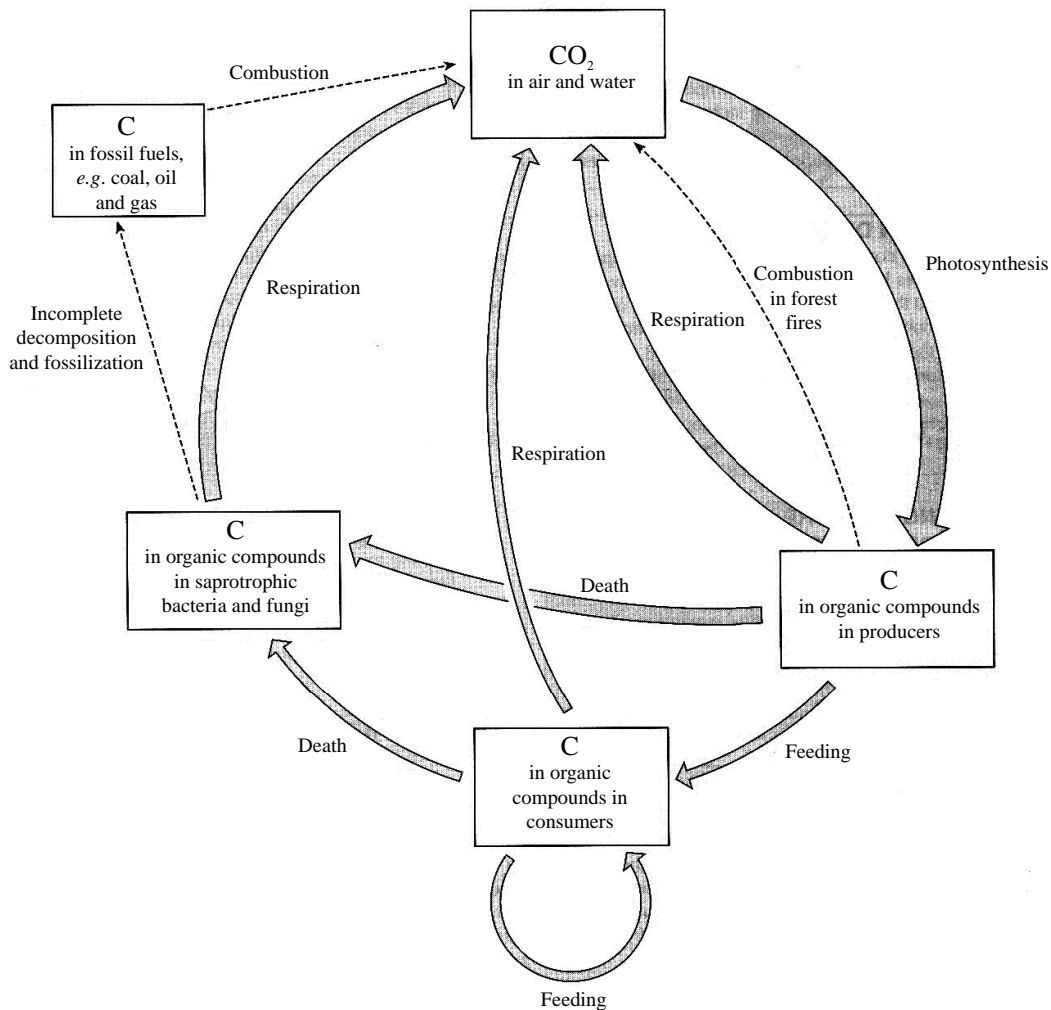
*For full [9 marks] candidates must have at least one well-drawn survivorship curve.*

*If no survivorship curve graphs are included, award [7 max].*

*If no graphs provided, award [7 max].*

*Expression of ideas [3 max]*

7. (a)



[Source: adapted from A Allot, *Biology for the IB Diploma*, Oxford University Press, (2001), page 43]

*Award [3 max] for diagram as follows:  
 Four storages [1].  
 Three processes [1].  
 General accuracy and appearance of diagram [1].*

fixation of C from atmosphere by photosynthesis;  
 feeding on plant material by herbivores;  
 feeding on herbivores by carnivores;  
 cellulose-reducing (and other) bacteria return organic bacteria to atmosphere through decomposition;  
 CO<sub>2</sub> from atmosphere dissolves in rainwater;  
 reacts with rocks;  
 hydrogen carbonates carried to sea;  
 carbonate incorporated in organisms (e.g. corals) → limestones;  
 incomplete decomposition of organic matter → peat → coal;  
 burning of coal and oil returns C to atmosphere;  
 natural emissions (e.g. volcanoes);  
 Any other reasonable points.  
 Any 4 of the above points for [4 max].  
 Allow credit for these points if included on diagram.

[7 max]

- (b) flow of energy through system is responsible for transfer and transformation of carbon;  
amount of CO<sub>2</sub> in atmosphere influences amount of heat energy that passes through;  
sunlight energy utilized in photosynthesis;  
so forests are important energy stores as well as carbon storages;  
other organisms all require energy for metabolism, obtaining it from consuming carbohydrates, *etc.*;  
decomposition of organic matter releases energy stored as chemical energy in carbon compounds;  
coal/oil/gas formation stores energy as chemical energy in the lithosphere;  
also release of energy in bushfires: returns energy from organic matter to atmosphere;  
*Any other reasonable points.*

[6 max]

- (c) burning of coal/oil/gas releases CO<sub>2</sub> to atmosphere enormously speeding up circulation;  
clearance of forests releases CO<sub>2</sub> and speeds up circulation;  
drainage of swamps/wetlands releases CO<sub>2</sub> and speeds up circulation;  
reafforestation/establishment of plantations provides carbon storages and slows circulation;  
shift to alternative energy sources and use of public transport reduces fuel burning and slows circulation;  
*Any other reasonable points.*

[4 max]

*Expression of ideas [3 max]*

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