

MARKSCHEME

November 2003

ENVIRONMENTAL SYSTEMS

Standard Level

Paper 2

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 prescribed number of questions, mark only the required number of answers in the order in which they are presented in the script. Make a comment to this effect in the left hand margin.
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:

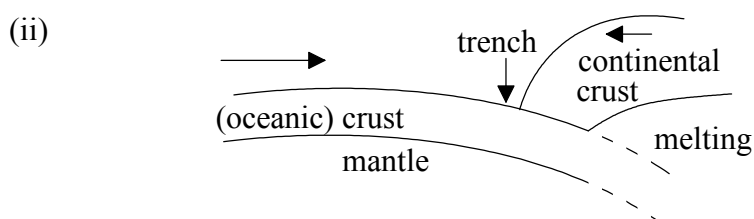
- ♦ Each marking point has a separate line and the end is signified by means of a semicolon (;).
- ♦ An alternative answer or wording is indicated in the markscheme by a “/”; either wording can be accepted.
- ♦ Words in (...) in the markscheme are not necessary to gain the mark.
- ♦ The order of points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

SECTION A

1. (a) (i) between 1880 and about 1920, temperatures were mostly below the mean;
between 1920 and 1980, temperatures fluctuated above and below the mean;
after 1980, temperatures were consistently above the mean;
or any reasonable alternative; **[3 max]**
If candidate has taken vertical axis to represent absolute temperatures (e.g 0.6 °C) rather than temperatures above and below the mean, award [2 max]
- (ii) burning of fossil fuels / draining of wetlands produces more methane / increasing livestock increases methane / deforestation leading to enhanced greenhouse effect / global warming **[1 max]**
- (b) (i) Allow 0.80 – 0.90 °C **[1]**
- (ii) Allow 1.50 – 1.60 °C **[1]**
The total range of temperatures is required to be calculated - a single figure (e.g 0.85 °C). No marks if a candidate copies the highest and lowest figures from the graph (i.e gives two figures).
- (c) water has a greater heat capacity than land / takes longer to warm and to cool than the land / differences between specific heat capacity of rock and water;
so ocean temperatures fluctuate less than land temperatures / oceans warm and cool more slowly than continents; **[2]**

2. (a) ash would reflect sunlight back to space / prevent sunlight penetrating atmosphere / increases albedo;
reduction in energy input leads to fall in global temperatures; [2]
If it is argued that greenhouse gases are expelled along with ash, and these could contribute to temperature increases, allow [2] if well argued.

- (b) (i) subduction zones occur at destructive margins, where one plate is destroyed (as it sinks beneath another) [1]
Answers must have “destructive margin” and an explanation demonstrating understanding of the term to gain the mark.



appropriately labelled diagram showing:

- one plate subsiding beneath another;
- arrows showing direction of movement of plates;
- separate layers of crust and mantle;
- trench at contact point between plates;
- crustal plate melting as it descends;

[3 max]

- (iii) heat generated as plates move beneath each other;
molten magma rises through fissures producing volcanoes;
plates / rocks moving past each other cause earthquakes;
pressure increases due to production of volatile gases;
increased mass / weight / volume of two plates in zone;

[2 max]

- (c) (i) sulfur (di)oxide;
nitrogen oxide;
carbon dioxide; [2 max]

- (ii) burning fossil fuels in power stations;
vehicle exhausts;
industrial sources;
deforestation; [2 max]

- (iii) [2 max] for ways of reducing acid emission. [2 max] for evaluative comments.
wet scrubbers to remove sulfur dioxide from power station emissions;
but this is expensive;
so developing countries cannot afford it;
catalytic converters (CATs) to remove nitrogen oxides from vehicle exhausts;
but these only remove part of the pollution (e.g. not carbon dioxide);
energy conservation measures reducing demand and hence total pollution;
replacing fossil fuel power stations with renewable energy sources;
replacing fossil fuel vehicles with less polluting alternatives;
which also reduces pollution by other pollutants;
international agreements to reduce emissions; [4 max]

3. (a) natural resources, (living or non-living) which may be exploited to produce natural income. [1]
The simple phrase “natural resources” is insufficient.
- (b) renewable = living resources which can be replaced by natural productivity at least as fast as they are used *e.g.* timber / food / biofuels;
non-renewable = resources which cannot be replaced at the same rate at which they are used *e.g.* quarried or mined geological resources, fossil fuels;
replenishable resources = non-living resources which are replaced by natural processes at least as fast as they are used *e.g.* freshwater; [3]
Strict adherence to the information provided is not required.
- (c) timber can be extracted provided trees are planted or allowed to regenerate at same rate nearby;
water can be extracted from lake provided natural rainfall refills it at the same rate over a short period of time;
need to prevent pollution of lake from quarrying or forestry activities;
or other valid suggestions; [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.

4. (a) *Deduct [1] for each error or omission e.g. “A + B could be pyramids of numbers, A could be a pyramid of biomass or productivity” receives [2].*

A and B could be pyramids of numbers;
 A and B could be pyramids of biomass;
 only A can be a pyramid of productivity;

[3 max]

Note that it might be argued that productivity is a flow and should not be represented by a diagram of this sort, so neither A nor B can represent productivity. This response may be credited provided a correct supporting argument is given.

In the following three sections, credit any valid argument showing sound ecological reasoning and other equally valid examples.

pyramids of numbers:

a few large individual producers can support many consumers as in B or many producers may support fewer consumers as in A / shape of pyramid depends on relative size of organisms;

for pyramid B: e.g. in a woodland, a few oak trees may provide food for many caterpillars / aphids etc. which in turn are eaten by e.g. fewer robins, which are eaten by e.g. very few sparrow hawks;

for pyramid A: e.g. in the African Savannah, many grass plants support smaller numbers of invertebrates / and large grazing mammals etc.;

[3 max]

pyramids of biomass:

pyramids of biomass show storage of biomass at a particular moment in time;
 pyramids of type A show much less biomass stored at each successive trophic level, because organisms at successively higher levels are less productive;

pyramids of type B are called inverted pyramids (of biomass);

highly productive organisms may have a small biomass, but reproduce so quickly that they can support a larger biomass of (longer lived) organisms;

e.g. in sea / lake / river phytoplankton are food for larger biomass of zooplankton, which feed lesser biomass of fish;

temporary immigration of organisms e.g. shoal of fish / flock of birds;

[3 max]

pyramids of productivity:

productivity pyramids represent rate at which energy flows through (successive) trophic levels;

which must be less at higher trophic levels because of the second law of thermodynamics / 10 % rule;

since some energy is always lost as heat of respiration at each trophic level;

e.g. energy available in Australian eucalypt forest for invertebrates, birds / climbing mammals to eat is less than energy available to carnivorous birds eating invertebrates; **[3 max]**

*If the answer argues that productivity is a flow and so cannot be represented by either pyramid, credit answer as follows, up to **[3 max]**.*

productivity is a flow not a storage;

so cannot be represented by a pyramid diagram;

arrows should be used to show flows;

*If the answer incorrectly interprets the productivity pyramid as an energy pyramid (stored biomass converted to energy) allow **[1 max]**.*

[12 max]

- (b) productivity pyramid becomes wider at all levels;
because plants would be able to photosynthesis faster / have longer growing season;
because low temperature / low precipitation / frozen permafrost / soil limit productivity currently;
productivity of consumers would also increase because of greater productivity base;
diversity would increase as climate became suitable for wider range of organisms;
productivity pyramid could become higher / have more levels;
because food chains become longer as productivity increases;

[5 max]

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

Total [20]

5. (a) more developed countries have smaller rate of increase than less developed countries;
Germany has decreasing population, but small population;
India has high rate of increase and large population;
countries with large populations and high rates of increase have greater effect on
future global population increase or converse argument;
less developed countries tend to have more individuals less than 15 years old;
so they may have higher rate of increase in the future; [6 max]
Credit other valid points.
- (b) reasons for differences in growth rate:
countries with low growth rate have more doctors *per capita*, and consequently lower
infant mortality;
so couple need only have few children to ensure some survive to adulthood;
contraceptive advice / supplies readily available;
countries with high growth rate are poor, so want many children as labour to work
land / care for them in old age;
education available to women in low growth rate countries, so they know how to
plan families;
can care better for their children;
are more economically independent; [4 max]
- international policies:
may decrease rate of growth by providing:
aid from developed countries to train local health care workers;
contraceptive advice / supplies;
training / education for women to encourage personal and economic independence;
seeds for local farmers;
- may increase rate of growth:
by decreasing death rate through better sanitation, better medical care;
by improved agricultural methods; [2 max]
[6 max]
- (c) carrying capacity is maximum number of humans which can be supported
sustainably by the planet; [1]
- more energy efficiency:
trapping more solar energy for providing power *e.g.* solar / wind / tides / hydro;
exploiting geothermal energy resources;
more efficient use of energy so less is required *e.g.* better home insulation / more
efficient machines; [2 max]
- others:
increasing food production:
development of higher yielding varieties which do not require additional inputs;
- reduction / reuse of materials:
recycling of glass / metals *etc.*;
acceptance of “simpler” lifestyle by developed nations;
technical “fixes” for reducing pollution load; [2 max]
- [2 max] for any of the above or other valid points up to a maximum of [5 max].
Any reasonable, relevant points should be credited.*

Expression of ideas [3 max]

Total [20]

6. (a) **Differences**

USA uses more water for non-essential purposes (*e.g.* car washing, gardening, washing machines *etc.*);
 industry represents 50 % of usage in USA and only 7 % in China because China is still developing;
 agriculture is the base of China's economy, so substantial amounts of water are needed for irrigation;
 power plant cooling is less significant in China;

Changes

availability of water: *e.g.* enormous increase in number of reservoirs and dams since 1950;
 applies to both developed and developing countries / specific examples;
 average figures may conceal enormous local differences as withdrawal rates have increased 5-fold, but *per capita* use has only tripled;
 so population must have increased;
 increases in standard of living account for increase in water demand;
Credit other valid responses.

[7 max]

(b) an increase in the following activities makes demands on the supplies of fresh water:

agriculture (irrigation);
 provision of water for stock;
 increased industrialization (manufactured products);
 public uses such as street cleaning, watering of parks;
 enlargement of urban areas;

Any other reasonable points, e.g.

increase in population has contributed to large increase in pollution *e.g.* eutrophication;
 industrial and sewage pollution of rivers;
 contamination of aquifers by industrial activities *e.g.* leaking fuel tanks, heavy metals;
 excessive water pumping of aquifers leading to salination of water in coastal areas;
 in some areas water use is exceeding available supplies;
 this leads to political difficulties;

[7 max]

(c) inputs (*e.g.* precipitation; irrigation);

transfers and transformations (*e.g.* infiltration; weathering);
 solution of chemicals making them available to plants;

outputs (*e.g.* uptake by plants; leaching; runoff; soil erosion; evaporation);

[3 max]

References to inputs / outputs / transfers and transformations, although relevant, are not required.

Reward strong comparative argument and sound evaluation.

Expression of ideas [3 max]

Total [20]