IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

MARKSCHEME

May 2005

ENVIRONMENTAL SYSTEMS

Standard Level

Paper 3

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 penalizing 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. *The organism chosen must be a consumer. If a producer is chosen, award* ***[2 max]****.*

Description: ***[3 max]***
weigh the organism and place it into an enclosure;
each day weigh the food provided;
collect leftover food and feces (the wastes) and weigh them;
after a given period of time *e.g.* 1 month, reweigh the organism;
gross productivity is food eaten minus the wastes;
net productivity is the increase in animal biomass;
productivity must be given as mass (g or kg) per unit time;
Description of biomass alone award ***[2 max]****.*

Evaluation: ***[2 max]***
the animal must be provided with an ample amount of food;
it may be difficult to determine an appropriate diet for the animal;
the animal may become stressed and unwell in captivity;
water must be provided to keep the animal alive and may increase the mass of the wastes being weighed;
it is very difficult to collect all leftover food and feces (particularly for aquatic animals);
a number of animals should be involved in the testing and averages taken;
the artificial environment may contribute to errors as the animal will have unusually low levels of activity;
problem of moving some organisms (*e.g.* limpets, barnacles) from their habitat; ***[5 max]***
Any other reasonable points.

A2. (a) diversity is the variety of organisms per unit area / species diversity is a measure of the number of different species present and the relative numbers of individuals of each species; ***[1]***
Do not allow just "number of species". Allow "number of organisms/plants and animals in an ecosystem" or OWTTE. Accept correct definitions given in terms of genetic or habitat diversity.

(b) (i) $D = \frac{N(N-1)}{\Sigma n(n-1)}$ ***or*** $\frac{33(33-1)}{(5\times4)+(4\times3)+(12\times11)+(7\times6)+(5\times4)}$;
ecosystem B, $D = 4.67$; *(accept 4.60 to 4.70)* ***[2]***

(ii) ecosystem A has a lower value of D due to pollution/agricultural activity/ disturbance;
ecosystem A is a more immature ecosystem / different soil/different microclimate;
ecosystem A is an extreme environment (such as desert, tundra, salt lake); ***[1 max]***
Any other reasonable suggestions.
Allow "human involvement/activities".
Do not allow "greater evenness/uniformity in abundance" or OWTTE.

A3. (a) *Appropriate method for named species* ***[1 max]*** *e.g.*
capture–mark–release–recapture / Lincoln index;
quadrat for non-motile organisms;
aerial surveying for very large animals;
Do not allow "human" as a named species. For parts (b) and (c) however, allow some ECF where this is the case and where the answers given make sense in this context.

Description: ***[1 max]*** *e.g. for capture–mark–release–recapture–method*.
marked unit area;
apply a paint spot / ear tag / leg ring / radio transmitter to the captured animals;
second catch must be from same marked area;
calculate population density / population = $\frac{\text{total in first catch} \times \text{total in second catch}}{\text{number of marked organisms in second catch}}$;

Evaluation: ***[2 max]***
it is important that marking does not increase the death rate of the organisms;
sufficient time must elapse to allow mixing of population to occur;
species that are difficult to catch may give low result;
problem of trap-shy and trap-prone individuals;
difficult to assess population size for very short-lived organisms;
organisms may move in and out of study area;
any other reasonable points; ***[4 max]***

(b) effluent discharge / nutrient run-off / habitat destruction / land clearing / overexploitation / introduced species; ***[1]***
Any other suitable suggestion.

(c) *Method must be relevant to named species.*
baseline measurement required;
before human impact occurred (*e.g.* before the pollution was introduced);
measurements should be taken at regular intervals to determine the impact; ***[2 max]***

A4. (a) *Material presented will vary according to the ecosystem selected. Examples are given below. Do not allow a description of changes over 24 hours.*

marine ecosystem:
e.g. rocky coastline at Bay of Biscay, Bilbao, Spain;
temperature varies as the distance above the low tide line increases;
it would be warmer in summer and cooler in winter at higher levels;
currents might affect the temperature;
rocks pools often have greater extremes of temperature;

or:
terrestrial ecosystem:
e.g. a pine plantation at Les Landes in south-west France;
ground temperature inside the forest is milder (with less variation) than the ground temperature outside the forest;
variation in temperature is greater in the forest canopy than at ground level; ***[2 max]***
*Award **[1]** for name of system and **[1]** for how the temperature varies. Name of ecosystem need not be too specific, allow tropical rainforest, rocky coast or deciduous woodland.*

(b) *marine ecosystem*:
generation of energy using nuclear power station;
water is used for the cooling system of the power station and the release of warm water increases the temperature;

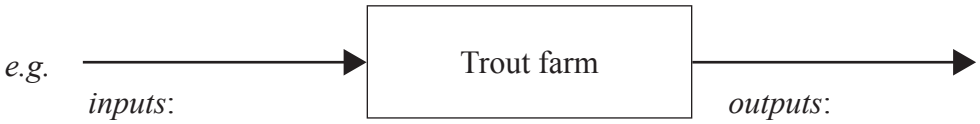
terrestrial ecosystem:
deforestation / harvesting of timber;
deforestation allows more sunlight to reach the ground level and increases the ground temperature; ***[2 max[***
*Award **[1]** for human activity and **[1]** for how this increases temperature.*
Do not allow "global warming" or "greenhouse effect". Allow burning of fossil fuel leading to increase in atmospheric CO_2 , which leads to increase in temperature, if well argued.

Option B — Impacts of Resource Exploitation

B1. (a) named commercial farming system *e.g.* trout farm in Victoria, Australia;

*Award **[4 max]** for a flow diagram featuring the following.*
*Inputs: **[2 max]***
food / fertilizer / growth hormones;
water;
seeds;
fungicides / pesticides;
fossil fuels / petrol / oil / electricity / energy subsidy;
manpower;

*Outputs: **[2 max]***
harvest / yield;
excess (waste) fertilizer/food;
crop remains / dead animals;
animal waste;
pollution of air/water;



inputs:
young fish
food pellets
salt (used as a fungicide)
growth hormones
water

outputs:
mature fish
food remains
fish wastes
dead fish
salt, hormones in water **[5 max]**

(b) *Award **[4 max]** if the subsistence system is not named.*

Subsistence system	Commercial system
for own family with a little to share with the community	for profit;
small scale	large scale (*i.e.* extensive) / but may be intensive;
polyculture used	monoculture used;
more likely to grow traditional varieties	new, best varieties (high yield varieties) usually grown;
genetic diversity maintained	selective breeding leads to loss of genetic diversity;
labour intensive	not labour intensive / machinery used;
less polluting	more polluting/petrol used for machinery / pesticides and fertilizers used to maximize yield;

[5 max]

Allow any other appropriate points. Comparison must be made to gain full credit.

(c) increase use of fertilizers to increase yield;
increase energy subsidy to make systems more intensive;
increase use of pesticides to reduce pest damage;
increase irrigation to increase yield;
develop new varieties which resist pests / tolerate salty conditions / have low water requirements;
develop new foods and food supplements;
genetically modify foods;
preference for organic foods in affluent/developed countries;
extension of agriculture into marginal land;
improve food storage/preservation techniques; ***[4 max]***
Any other reasonable points.

B2. (a)

	Developed countries	**Developing countries**
cereals	$100 \times \frac{(750 - 700)}{700}$ = 7 %; *(accept 6 to 8 %)*	$100 \times \frac{(1200 - 600)}{600}$ = 100 %; *(accept 98 to 102 %)*

[2]

(b) demand for meat and cereals both increasing as human population increases;
developing countries have a larger increase than developed countries as the rate of population increase is greater;
demand for meat in developing countries is increasing more than the demand for cereals as demographic transition progresses/GNP increases and more people can afford meat; ***[2 max]***
Any other reasonable points.
Must have an explanation. A simple description of the graphs or restatement of the data is not sufficient.

(c) increase in ecological footprint;
gap between developed and developing countries is diminishing;
footprint depends on population and *per capita* consumption;
both these are increasing in developing countries;
need for developing countries to import food; ***[2 max]***

Option C — Conservation and Biodiversity

C1. (a) (i) amphibians 16.7 %; *(accept 16 to 17 %)* ***[1]***
Both required for the mark.

(ii) freshwater fish 4.9 %; *(accept 4 to 5 %)* ***[1]***
Both required for the mark.

(b) (i) facing a very high risk of extinction in the wild in the near future; ***[1]***

(ii) example of currently endangered species *e.g.* giant panda / blue whale; ***[1]***

(iii) *Reasons*: ***[3 max]***
small population;
extremely specialized / specialized habitat;
restricted food source;
low reproductive potential;
accumulation of toxins;
a prominent predator, so killed by farmers protecting their stock;
migrates long distances;

Consequences: ***[2 max]***
loss of species diversity;
loss of aesthetic value;
loss of habitat;
may be crucial to its food web / keystone species;
may have contributed to mankind as a medical, or other, resource in the future; ***[5 max]***
Reasons must be appropriate for the species selected in (b)(ii).

C2. *Description*: ***[2 max]***
predators/diseases controlled;
populations can build up quickly;
habitat and food abundant;
so reduced competition;
usually done in zoos / occasionally in semi wild enclosures;
small population obtained from wild or captive stock;
enclosures often made as similar to natural environment as possible;
sometimes individual animals exchanged between collections to prevent inbreeding;
specific examples of succesful prospects (*e.g.* Arabian oryx/Cambodian sunbear/orang-utang);
breeding may be assisted (by artificial insemination);
Any other reasonable point.

Evaluation: ***[3 max]***
conservation of habitat diversity should lead to conservation of species;
not all species breed easily in captivity;
difficult to maintain genetic diversity;
released animals may be easy targets for predators;
aesthetic values lead to an imbalance in conservation activity;
e.g. "cute and cuddly" (giant panda) or large and conspicuous (elephant) animals are conserved, but small and insignificant (such as Eltham copper butterfly) may not be part of the conservation program;
technical/economic difficulties for some countries; ***[5 max]***
In general, points on difficulties, problems, precautions or criticisms can be considered evaluative.

C3. (a) *governmental*: UNEP/United Nations Environment Programme;
Allow:
international (e.g. UNEP/United Nations Environment Programme)
national (e.g. United States National Parks Services / English Nature)
state (e.g. Victoria Parks and Wildlife Services)
non-governmental: Greenpeace / WWF / Worldwide Fund for Nature; ***[2]***

(b)

	Governmental organization	**Non-governmental organization**
use of media	media liaison officers prepare and read a written statement	use footage of activities (*e.g.* chasing whaling boats) to gain media attention;
speed of response	considered / slow / there must be consensus between member governments	rapid;
political / diplomatic constraints	considerable / activities are hindered by political decisions / there may be disagreements between political parties or member nations (international organizations)	unaffected by political considerations / activities may be illegal;
enforceability	international treaties and national or state laws can lead to prosecution of offenders	no power / use public opinion to pressure governments to act;

[4 max]

Allow any other reasonable points.
Comparisons must be made to gain full credit.

Option D — Pollution Management

D1. (a) (i) point source pollution is waste that comes from a single, clearly-identifiable site; ***[1]***

(ii) a pipe discharging domestic waste water/sewage/detergents (into the lake); ***[1]***

(iii) run-off from farms/animal sewage/silage/fertilizers / run-off and erosion from cultivation; ***[1]***

(b) point source pollution is easier to control and eliminate than non-point source pollution as the discharge can be treated or diverted/dealt with at source; ***[1]***

(c) measure nitrate/phosphate/turbidity levels;
repeatedly over a period of time;
measure turbidity by lowering a secchi disc into the water/turbidiometer/filtering water and weighing filtrate;
nitrate levels increase as input of nutrients increases / phosphate levels increase as input of nutrients increases / turbidity increases as algae populations increase;
measure amount of dissolved oxygen / BOD or similar; ***[2 max]***

(d) measure the abundance and diversity of species;
upstream/downstream measurements;
measurements on control/unpolluted area;
as eutrophication increases the abundance of organisms requiring high levels of dissolved oxygen would decrease;
the abundance of low oxygen tolerant species (*e.g.* carp) would increase;
species diversity would decrease;
few species survive in low oxygen environments;
indicator/sentinel organisms; ***[2 max]***

(e) *Description*: ***[2 max]***
add aerators to the lake (to maintain survival of species);
remove aquatic plants during their growing period;
dredge the mud from the bottom of the lake to remove nutrients;
add aluminium or iron salts to flocculate the phosphates and suspended particles;
introduce species of fish which consume algae;
reintroduction of native species of plants and animals;
Any other appropriate points.

Evaluation: ***[2 max]***
aerators are expensive to operate;
aerators do not reduce the pollution problem, so must be used continuously;
aquatic plants which have been removed from the lake transfer the nutrient overload to another ecosystem;
mud pumped from the lake transfers nutrient overload to another ecosystem;
flocs must be removed as aluminium is toxic; ***[4 max]***
No credit should be given for preventative factors such as use of alternative (non-P) detergents.

(f) Environmental Impact Assessment/EIA / baseline study must occur before any development begins;
select biological (species diversity) / chemical (nutrient status) indicators;
monitoring of the environment must continue at regular intervals during and after development; ***[2 max]***

D2. (a) $100 \times \frac{(91.2 + 23.9 + 25.1 + 188)}{354.7} = 92.5\%$; *(accept 92.0 to 93.0 %)* ***[1]***

(b) *To achieve full marks the answer must include at least one evaluation comment.*
most of the waste generated can be recycled or composted;
some of the waste could be reused *e.g.* jars / bottles / textiles;
composting and recycling would significantly reduce the amount of domestic waste going to landfill / combustion;
hazardous wastes must be treated appropriately to reduce environmental damage;
the advantages of reducing landfill should be explained to householders;
incentives may be necessary to encourage householders to recycle rubbish;
recycling is cheaper if householders sort their own waste;
recycling will not continue if there is no demand for recycled goods;
manufacturers may be made responsible for the final disposal of large items *e.g.* cars / refrigerators; ***[3 max]***
Any other reasonable point.

D3. cheap / convenient;
provide a method of reclaiming old quarries and gravel pits;
methane may be extracted as an alternative energy source;
soil cover prevents many health problems;
not always close to sources / cost of transportation;
requires large area;
smells;
rats and other vermin;
unsightly;
may cause environmental problems if badly managed;
food wastes may generate methane (potentially explosive);
leachate may be polluted / possible contamination of groundwater;
requires planning for economical operation / supplies of soil for cover;
waste of land, especially where land is very expensive; ***[2 max]***