MARKSCHEME

NOVEMBER 2006

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 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) $D = \frac{27 \times 26}{108}$;
$= 6.5$; ***[2]***
*Award **[1]** if the correct answer is given but no workings are shown.*

(b) presence of legs;
number of legs;
presence of antennae/feelers;
tail presence/absence;
body shape;
colour;
size; ***[2 max]***
Any other appropriate suggestions.

(c) (i) name of appropriate abiotic factor;
Accept either terrestrial or aquatic factors, e.g.
air/soil/water temperature;
aspect;
salinity;
dissolved oxygen;
pH; ***[1 max]***

(ii) *Reward responses which indicate that factors affecting diversity are understood and which relate to the chosen abiotic factor.*

e.g. dissolved oxygen:
some organisms can only live in water with high levels of dissolved oxygen;
in a highly oxygenated environment, the number of species (species richness) will be higher and hence the diversity will be greater;
or
in water with low levels of dissolved oxygen, only a few specially adapted organisms can survive;
a few species tend to be dominant (and a few others may exist in small numbers), so diversity is low; ***[2 max]***

(iii) name/description of measuring instrument/procedures appropriate to abiotic factor; ***[1]***

*Award **[2 max]** for:*
repeated measurements to check validity;
measurements at both sites at same time/same day;
other appropriate comments on ensuring a fair test; ***[2 max]***

(d) (i) mark and recapture technique/Lincoln index; ***[1]***

(ii) $\left(\frac{20}{5}\times 8\right) = 32$; ***[1]***

(iii) emigration / immigration;
birth / death;
predation;
very small sample size;
may interfere with relationships of other individuals in population; ***[1 max]***
Any other valid suggestions.
Do not accept human error and equivalent generalities.

(iv) increased chance of predation / possible toxicity of paint; ***[1]***

(e) (i) need to know inputs of energy;
not all food is absorbed / feces is an output; ***[2]***

(ii) water is not organic matter / moisture content is variable / comparisons of wet weights not fair test / so that results can be extrapolated for remainder of batch / *OWTTE;* ***[1]***

(iii) energy absorbed = food eaten – feces;
burn food/feces to measure energy content / use conversion tables to convert mass to energy equivalent; ***[2]***

(iv) net productivity = animal mass at end – animal mass at start; ***[1]***

Option B — Impacts of Resource Exploitation

B1. (a) (i) per person/per head of population; ***[1]***

(ii) Malaysia; ***[1]***

(iii) $\left(\frac{18}{51.2}\times 100\right) = 35\% \text{ / } 35.2\%$; ***[1]***

(b) (i) ecological footprint is area of land but carrying capacity is number of people / ecological footprint $= \frac{1}{\text{carrying capacity}}$ / or *vice versa* / ecological footprint is area of land needed to provide food and absorb waste, but carrying capacity is maximum population that an area can support; ***[1]***

(ii) Indonesia; ***[1]***

(iii) people in developed countries eat more meat / crop higher in food chain;
animals farmed for meat are often fed grain;
only about 10 % of energy from grain is converted to meat;
so more land needed than if grain were eaten directly by people; ***[2 max]***

(iv) developed countries use more fossil fuels, generating much CO_2;
land needed (to grow trees) to absorb this pollution;
developed countries eat more food/import a lot of food;
so more land needed to grow extra food/transport food;
more fertilizers and pesticides used to produce food; ***[3 max]***
Any other valid points.

(c) (i) hydroelectric power does not emit carbon dioxide (except in construction), so less land needed to absorb waste (reducing footprint); ***[1]***
Both statements are necessary for the mark.

(ii) dams cause flooding of homes/farmland/landscapes;
dam affects water flow of river downstream;
consequent damage to aquatic ecosystems/fishing/irrigated cropland;
increased incidence of waterborne disease (*e.g.* schistosomiasis);
costly to construct;
ecological damage and pollution associated with construction;
dam failure is catastrophic for populations downstream;
dam is barrier to migrating fish (*e.g.* salmon/eels); ***[2 max]***

(d) (i) *Accept any suitable example.*
Name of food production system:
e.g. cattle ranching / nomadic pastoralism / intensive cereal production / battery chickens / glasshouse vegetables / slash and burn *etc.*;

***Input*:**	***Output:***
e.g. food; electricity; fuel; heat; light; labour; water; *Three appropriate inputs of energy or materials required.*	*named food*: *e.g.* meat/eggs/grain/vegetables; *named pollutant*: *e.g.* pesticides; heat energy; manure; *Three appropriate outputs of energy or materials required.*

*Award **[1]** for name of system, **[1]** for two correct inputs and two correct outputs, and **[1]** for third correct input and output.* ***[4 max]***

(ii) *System is unsustainable because*:
non-renewable resources are being used up;
pesticides/fertilizers cause permanent damage to natural ecosystems;
pollutants spread through natural food web with unknown consequences;
agricultural systems often reduce biodiversity;
fossil fuel use in machinery/agrochemical production enhances greenhouse effect;
tilling/animals expose soil leading to erosion;
any correct specific example illustrating unsustainability;
reduction in land area available for slash and burn/nomadic pastoralism intensifies pressure on soil and other resources;
intensive forms of agriculture produce wastes which may lead to eutrophication;
resulting in desertification / soil and forest destruction;
monoculture requires use of chemicals to control pests;
energy lost through cropping greater than productivity;
Any other valid point.

or

System is sustainable because:
natural processes *e.g.* legumes restore balance of nutrients;
polyculture/mixing animals and crops allows a natural system without artificial/ unsustainable inputs;
system relies on human/animal labour instead of fossil fuels; ***[3 max]***
Any other valid point.
Points can be credited from both lists.

Option C — Conservation and Biodiversity

C1. (a) provide habitat/food/shelter/place to mate / make nest / staging post for migrating birds; ***[1]***

(b) Philippines; ***[1]***

(c) $\left(\frac{0.132 \times 100}{51.2} =\right) 0.26\% / 0.258\%$; ***[1]***

(d) drainage dries out habitat reducing (invertebrate) food available to birds;
development/construction destroys habitats;
fishing/hunting/recreational use disturbs birds when nesting/feeding;
reed cutting disrupts feeding/breeding habitats;
use of pesticides may poison birds;
use of pesticides may poison their prey;
introduction of exotic species;
birds killed by ingesting lead fishing weights; ***[3 max]***
Any other reasonable suggestion.
Do not credit vague responses such as pollution.

C2. (a) reserve A would be more effective than reserve B;
reserve A has smaller perimeter than reserve B, so disturbance is less likely / edge effects less pronounced;
reserve B has longer perimeter so edge effects more pronounced which might increase biodiversity;
animals more likely to wander out of reserve B than reserve A because of shape;
cropland is managed more intensively than forest;
drift of pollutants/crop sprays may affect reserve surrounded by cropland;
in cropland, sowing, weeding/fertilizing and harvesting occur at least once a year causing disturbance to reserve;
forest provides a better buffer zone than cropland;
forest provides wider variety of habitats/food sources for species moving beyond reserve boundaries; ***[4 max]***
There must be at least one reference to shape and one to management of surrounding land for full credit.

(b) (i) rare;
vulnerable;
threatened;
endangered;
indeterminate/unknown;
extinct; ***[2 max]***
*Award **[2]** for four correct, **[1]** for three or two correct and **[0]** for one correct.*

(ii) *name of species*: *e.g.* Sumatran tiger (*no mark awarded for name*)

reasons:
top predator and little energy reaches top of pyramid;
loss of habitat;
large area needed for viable population;
hunted because seen as danger to humans/livestock;
fragmentation of habitat makes breeding difficult;
high market value of body parts encourages poaching;
low genetic diversity with low numbers;
introduction of diseases; ***[3 max]***
Any other valid points.
*Award **[2 max]** if name is not given.*

(iii) species at trophic level below become more numerous;
species at trophic level above become less numerous
shortened food chain produces imbalances at other trophic levels;
sick/weak animals no longer "culled";
less fit individuals lower down food chain survive to breed;
decomposer organisms, *etc*. associated with dung eliminated; ***[3 max]***

(c) CITES is Convention on International Trade in Endangered Species (of Wild Fauna and Flora);
countries agree to monitor trade in threatened species (and their products) at ports and airports;
illegal imports/exports are confiscated to discourage illegal trade;
if trade in organism (or parts) can be reduced, pressure on wild population reduced;
suitable example of CITES in action;
list of threatened species is formally agreed (in separate schedule); ***[2 max]***

Option D — Pollution Management

D1. (a) oxygen required to break down organic material in water / *OWTTE;* ***[1]***

(b) Indonesia; ***[1]***

(c) $\left(\frac{(257-214)}{214}\times 100\right) = 20\% / 20.09\%$; ***[1]***

(d) sewage;
agriculture (slurry/manure *etc.*);
fish farming;
tanning; ***[2 max]***
Any other reasonable suggestion.

(e) more sewage/food because of increasing population;
increased/more intensive agriculture to feed larger population;
more demand for processed food as more people move to cities/become more affluent;
increased demand for paper (caused by electronic revolution); ***[2 max]***

D2. (a) eutrophic/eutrophication/eutrophified; ***[1]***

(b) excessive growth of algae/algal blooms;
herbivore populations too small to control algae;
algae shade out larger water plants so they die;
excess algae sink to bottom;
bacteria decompose dead vegetation and use up oxygen;
oxygen levels fall very low;
most organisms die due to lack of oxygen;
black necrotic mud accumulates on bottom;
methane/sulfurous gases emitted;
deep-rooted plants may grow more quickly; ***[3 max]***
Do not credit eutrophication twice.

(c) treating sewage effluent by chemically precipitating phosphates and nitrates;
extra treatment stage increases costs / precipitated material requires disposal / manufacture of chemicals used for precipitation may use fossil fuels / cause pollution / *OWTTE*;

filtering effluent through reed beds to remove excess nutrients;
uses land which is then unavailable for other purposes / may provide additional habitat for wildlife / simple or inexpensive or low impact solution;

fertilizer/manure only applied to fields in dry weather;
fertilizer/manure only applied to fields when plants growing actively;
(evaluation) hard to predict weather;

use slow release/pelleted fertilizer;
limits leaching of nutrients (but difficult to achieve in unsettled / variable climates);

pasture/cropland replaced by forest in catchment / reduction in rate of bush/forest clearance;
pasture/cropland may be needed for food production;

use of low phosphate detergents;
but may be more expensive; ***[4 max]***
*For full credit each valid suggestion must be matched by an evaluative comment. Award **[2 max]** if no evaluation.*

D3. (a) *Accept any valid example e.g.*
heavy metals / name of heavy metal / oil / radioactive isotopes
Do not award credit for name of pollutant.

low levels may (bio) accumulate to toxic levels in animals;
toxins may accumulate in particular organs;
suitable example, such as oyster shells from Derwent estuary near Hobart contained zinc from nearby metallurgical works;
few plant species will be able to survive in contaminated land, limiting productivity;
heavy metals affect neurological function in animals;
heavy metals dissolve readily in acidic water, thus entering food chain;
radioisotopes have complex effects on ecosystems;
e.g. disturb hormones controlling breeding cycle in birds; ***[3 max]***
*Credit any other reasonable points. Award **[0]** if no pollutant is named.*

(b) *Methods must be appropriate to pollutant named e.g.*
replacement of contaminated soil with fresh soil;
bioremediation (growing plants to take up pollution then removing them/bacterial breakdown);
chemical treatment; ***[2 max]***