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MARKSCHEME

MAY 2009

ENVIRONMENTAL SYSTEMS

Standard Level

Paper 3

15 pages

Subject Details: Environmental Systems SL Paper 3 Markscheme

Mark Allocation

Candidates are required to answer questions from **TWO** of the Options **[2 × 20 marks]**.
Maximum total = **[40 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.

Option A — Analysing Ecosystems

A1. (a) sum of (total marked before day 4) = 8 + 19 + 8 = 35;

total pop = $\frac{\text{total in recapture} \times \text{total marked}}{\text{number marked in recapture}}$ / = $\frac{23 \times 35}{8} = 100.6$; *(accept 100 or 101)*

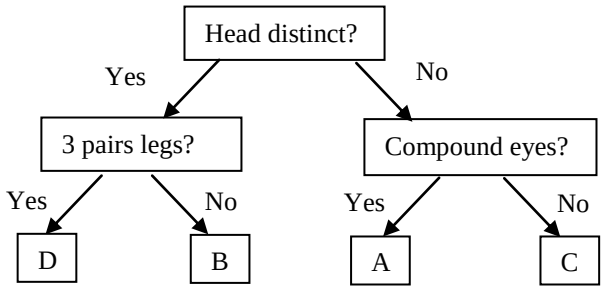
*Award **[1]** for correct "total marked", **[1]** for correct method of calculation, **[1]** for correct estimated population. However, allow **[2 max]** if 100.6 or 100.625 is given as the total, as a partial vole is an impossibility (if living). Allow ECF if (total marked up to day 4) is incorrect but correctly used in calculation.*
*Many have attempted to use Simpson's diversity index formula; award **[0]** in this case.* ***[3 max]***

(b) *Method of marking must:*
make individuals easily distinguishable from unmarked ones;
be sufficiently permanent to last through period of recapturing;
not affect the individual's chance of survival / *e.g.* through making them more noticeable to predators/by being toxic;
not affect their chance of being recaptured / *e.g.* through making animal particularly trap-shy/trap-prone;
Reject responses not related to marking method e.g. immigration. ***[2 max]***

A2. (a) *Key may be given either as paired statements e.g.*

1. 3 pairs legs…….Species D
   Not as above……..2
2. Head distinct.……Species B
   Head not distinct...3
3. Compound eyes….Species A
   Not as above……..Species C

or as a dendrogram e.g.:



*Award **[1]** for each correctly distinguished species.*
*Award **[3 max]** if either "life cycle" or "size" (or both) are used as characteristics.*
*Award **[1 max]** if good dendrogram or set of paired statements, but species wrong.* ***[4 max]***

(b) life cycle: not visible/apparent in the field;
size: the terms "small" and "large" are ambiguous/relative; ***[1 max]***

A3. (a) *A variety of valid factors and locations may be chosen by candidates.*

*Award **[1 max]**.*
reasonable description of variation between 2 locations;
Do not award credit for simply identifying a factor e.g. temperature.

*Award **[2 max]** for method.*
named instrument(s) for measurement;
multiple sampling in both locations;
involving variety of time of day/season/position;

e.g. temperature greater in Douglas fir zone than Spruce zone;
thermometer used to record temperature;
at ten different positions in each location;
every hour for 24 hours;
Reject "description" of ecosystem. ***[3 max]***

(b) mark out pairs of quadrats in each location;
ensuring both quadrats in a pair have similar density of the plant;
separate out/remove all biomass of plant from one quadrat in each pair at start of investigation;
dry and weigh these samples;
separate out/remove all biomass from second quadrats after given period;
dry and weigh second samples;
calculate difference between two weights to give net change in biomass;
use bomb calorimeter or conversion tables/other data to calculate energy equivalent;
Reject "description" of ecosystem. ***[5 max]***

(c) both quadrats in a pair began with very similar biomass;
significant grazing/trampling of plant in second quadrat did not take place between samples;
all biomass had been successfully removed in sampling;
no extraneous material had been included with dry weights (*e.g.* soil, roots of other species, *etc*.);
samples are representative of plant productivity for their location; ***[2 max]***
Reject "same size of quadrat".

Option B — Impacts of Resource Exploitation

B1. (a) land preparation equipment/tractors;
aircraft for spraying;
irrigation systems;
mechanical harvesters;
grain-drying equipment; ***[2 max]***
Any other reasonable answer.

(b) more seed sown per unit area/higher density in USA;
genetically superior seeds / seeds with richer food store in USA;
treatments of seed to improve germination, *etc*. in USA; ***[2 max]***
Any other reasonable answer.

(c) more fertilizer;
more pesticides;
better quality seeds;
machine harvesting;
genetic modification;
efficient irrigation; ***[2 max]***
Any other reasonable answer.

(d) *more fertilizer:*
inorganic nutrients/nitrates and phosphates;
may leach into aquatic systems;
causing eutrophication/growth of algae;
energy used in fertilizer production could generate greenhouse gases;

more pesticides:
could be non-specific affecting species in nearby ecosystems;
if non-biodegradable, could bioaccumulate;
threatening top carnivores especially;
pesticides reduce diversity of system and therefore stability;
energy for production could generate greenhouse gases;

better quality seeds:
farm-bred strains could disperse into local systems;
which may lead to genetic degeneration of wild stock;
or displace natural species through competition;
if genetic modification is involved there is the danger of recombinant DNA;

machine harvesting:
high energy consumption;
leading to reduction in non-renewable resources;
release of greenhouse gases;
non-selective destruction of species associated with crops; ***[2 max]***

Any other reasonable answer.

(e) *USA*:

$\frac{93915}{60646}$;

= 1.5;

Philippines:

$\frac{25217}{7667}$;

= 3.3;

*Award **[1]** for correct fractions or **[1]** for correct solutions for each country.*
Award no credit if wrong figures are used. ***[2 max]***

(f) assuming CO_2 production is proportional to energy expended;
greater efficiency will mean less carbon waste per unit of food (in Philippines);
which will reduce potential size of footprint (in Philippines);
although the higher productivity per unit area (in USA);
will also reduce potential size of footprint (in USA);
Award equal credit if statements are given in the converse e.g. "Lower efficiency will mean more carbon waste." etc. ***[2 max]***

(g) food consumption – the greater it is, the greater the footprint;
carbon waste from burning fossil fuels – the greater it is, the greater the footprint;
carbon fixation by local vegetation – the greater it is, the smaller the footprint;
Reject "number of cars" which in itself is insufficient. ***[2 max]***

B2. (a) oil and natural gas have shown steady increase;
leading to increased release of greenhouse gases/gases causing acid rain; (D)
proportionally faster increase in natural gas compared with oil;
which may mean less SOx emission where it is replacing oil use; (D)
coal consumption has remained fairly stable/shown slight decrease recently;
which will at least tend to stabilize carbon waste / SOx emissions; (D)
Any other reasonable suggestions. ***[3 max]***
*Award **[2 max]** if no discussion (D) of significance.*

(b) *nuclear:*
concern over radioactive waste disposal;
expense/difficulty of health and safety procedures;
concern over association with nuclear weaponry;
cost of establishing reactors;
limited technological know-how in some countries;
shortages/high cost/other difficulties in uranium supply;
occasional accidents/escapes (*e.g.* Chernobyl/Three Mile Island);

hydroelectric:
suitable sites for harnessing water power/many already used;
silted-up reservoirs/dams;
concern over impact on downstream ecosystems;
cost of establishing hydroelectric plants;
disturbance of fish migration;
flooding of ecosystems/settlements/farmland;
Any other reasonable suggestions. ***[3 max]***
*Award **[2 max]** if only one source is addressed.*
Reject "damage to environment/ecosystems" as too vague and insufficient.

Option C — Conservation and Biodiversity

C1. (a) more species of molluscs in the first place;
molluscs more likely to have (natural) predators;
many land snails have very low reproductive rates;
molluscs show low parental investment/care of offspring;
greater public/conservation interest in mammals; ***[2 max]***

(b) $(151+104+34+74=363$;
$363+40+11+24+46=484$;
$\%=\frac{100\times 363}{484})=75\%$;
*Award **[1]** for correct answer.*

*On islands there tend to be:**[2 max]***
smaller populations;
limited ranges/single populations;
many species have evolved in absence of predators/humans;
some islands are too small to support a population of predators;
so more vulnerable to introduced predators/human interference;
due to *e.g.* tameness, flightlessness and low reproductive rates;
taxonomic anomaly/tendency for island populations to be falsely classified as full species; ***[3 max]***

(c) (i) island pathogens/predators may not have evolved to affect exotics;
with these advantages exotics displace indigenous species through competition;
island prey/hosts may not have evolved resistance to exotic predators/parasites;
so may suffer heavy losses;
cats and rats are often carried on ships and are particularly destructive on islands when introduced/escape by accident; ***[2 max]***

(ii) natural hazards *e.g.* volcanoes/floods/drought;
global climatic change/global warming;
pollution;
disease; ***[1 max]***
Any other reasonable answers.

(d) genetic variation/mutations in colonizing/parent population;
island populations may be isolated from continental/parent populations;
and exposed to different natural selection/environmental pressures/specific island conditions (*e.g.* winglessness);
or may simply start with unusual proportions of genetic types (founder principle);
different variations may be selected in behaviour/physiology, *etc.*;
that prevent successful reproduction with parent populations;
by definition they will then represent new species; ***[4 max]***

(e) *Candidate responses may be very diverse depending on areas chosen, but any points of similar weight and validity to those given below should be credited.*

named area;
Should be a specific location, not just an ecosystem type e.g. Coto Doñana (Spain) and not "shore" or "swampland".

like islands:
limited area limits diversity;
and therefore stability;
limited area limits population of particular species and therefore gene pool;
contains species that are rare/threatened elsewhere;
so depends on thorough research of these species;
large perimeter exposed to external influences;
e.g. pollution/resource consumption/habitat destruction;
needs policing / close monitoring;
surrounded by different ecosystems;

other points:
economic/commercial pressures constitute threat;
sources of funding therefore important in success;
depends on good community support;
Any other reasonable answer. ***[5 max]***

(f) *governmental organizations may:*
initiate legislation;
enforce legislation;
e.g. for the protection of endangered species;
attach status to protected area by listing/identification;
place political/diplomatic pressure on other governments to support environmental initiatives;

non-governmental organizations may:
lobby governments for support;
provide proposals for legislation;
e.g. Man and Biosphere Reserves;
raise/donate funds for projects;
encourage (local) community support through education/publicity;
provide voluntary assistance in monitoring/restoration *etc*.;

Award similar credit for responses of equivalent weight and validity to those given.
Award up to ***[2 max]*** *if only governmental, or only non-governmental support, is addressed.* ***[3 max]***

Option D — Pollution Management

D1. (a) point source pollution involves emission of a pollutant from a readily identifiable/localized source; *(OWTTE)*
whereas non-point source pollution comes from multiple/dispersed sources/ sources that may be difficult to specify; *(OWTTE)*
The distinction may be made clear by the use of examples but no extra marks should be given. ***[2]***

(b) Biochemical Oxygen Demand is the amount of oxygen required for (full) decomposition/breakdown of the dead organic matter in a given volume of water;
It can be measured by:
measuring the original O_2 concentration in a water sample of known volume;
continuing to take O_2 concentrations until it becomes constant/all organic matter is decomposed;
subtracting final O_2 concentration from initial concentration to calculate quantity of O_2 used;
Award ***[1 max]*** *for definition of BOD and* ***[2 max]*** *for measurement.* ***[3 max]***

(c) *Answers will vary according to choice of factor.*

name of appropriate instrument/technique (*e.g.* O_2-meter, Winkler titration, chemical colour tests, filtration equipment);
collection of water samples both upstream and downstream;
using sampling points at regular intervals along length of river;
replication of samples at each point and estimate of mean value; ***[3 max]***

(d) accept answers from 20–45km downstream *(if a range is given it must fall completely within this given range)*;
justification:
algal growth is elevated/maximum over this range;
both nitrates and phosphates are elevated over this range (above upstream clean-water values);
O_2 is depressed over this range;
Award ***[1 max]*** *for location and* ***[1 max]*** *for justification.* ***[2 max]***

(e) *Tubificidae*;
justification:
because it shows a maximum population immediately after the point of discharge / where pollution is greatest;
indicating a high tolerance of pollution;
and therefore indicative of poor quality/more polluted ecosystem; ***[3 max]***
Award ***[1 max]*** *for "Tubificidae" and* ***[2 max]*** *for justification.*

(f) species diversity/number of different species;
pollution will limit variety of species adapted to (limiting) conditions;
or
abundance/number of individuals;
pollution will cause limiting conditions for growth/reproduction (of sensitive species);
pollution may cause increased growth of tolerant species; ***[2 max]***

D2. in the three step model of pollution (production, release, impact);
recycling intervenes at first step;
by reducing the production of pollutant;
which is clearly an advantageous strategy;
recycling is a better pollution management strategy for some resources than others;
for aluminium it is very effective;
reducing over 90% of all pollution;
for glass it is much less effective;
reducing atmospheric pollution by only 20%;
because of fossil fuel combustion in melting recycled glass;
no effect on aquatic pollution because original manufacture causes no significant water pollution;
paper recycling is quite effective at reducing atmospheric pollution;
but not so effective at reducing aquatic pollution because recycling process releases aquatic pollutants;
Any other reasonable answer. ***[5 max]***