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MARKSCHEME

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ENVIRONMENTAL SYSTEMS

Standard Level

Paper 3

14 pages

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. (a) *Responses must give a real name, or some appreciable detail for **[1]**.*
e.g. Woodlot with young deciduous trees, Fairground Road, Woodbridge, Connecticut, USA;
scrub at head of coral beach, West Island, Cocos, Indian Ocean.
Carnac Island – small rocky islet, off Fremantle, Western Australia.
swiftly flowing mountain stream, near Westendorf, Tyrol, Austria. ***[1 max]***
"Lake" or "rocky shore" will not suffice.

(b) *Award **[1]** for each pair of factors.*
For first example above:
soil pH, light intensity;
soil texture, temperature; ***[2 max]***

(c) *e.g. temperature in woodland ecosystem*:

describe:
use thermometer / thermograph;
standard conditions (*e.g.* same height above ground);
take mean of several readings;
repeat at regular intervals;
e.g. – over 24 hour period for diurnal variation;
– regularly over 12 months for annual variation;

evaluate:
problem of accurate readings – different people may read same instrument slightly differently;
environment itself may change; *e.g.* tree close to site may fall changing microclimate;
problem of collecting data under extreme conditions (*e.g.* snow, storm); ***[4 max]***
Any other reasonable points.
Answers should have at least one "evaluate" point to achieve full marks.

(d) ***Note**: a wide range of examples may be selected. Methods and changes must be appropriate for the type of area and the human activity chosen. Look for sound use of ecological reasoning.*

name of human activity;
use of environmental impact statement (EIS/EIA) approach / baseline survey;
before and after measurements;
nature of changes occurring (biotic or abiotic); ***[2 max]***
measurement of changes;
long-term monitoring; ***[4 max]***
Any other reasonable suggestion.

(e) *Exact method will depend on ecosystem selected. Method must be appropriate for ecosystem e.g.*
measure out quadrat;
or place number of quadrats (and take mean);
collect all plant material in quadrat(s);
remove all mineral and/or animal material (*e.g.* by washing);
remove moisture by heating / in oven;
may need to make allowance for underground plant material (roots) if these are impossible to collect;
may need to make allowance for dead material or remove this in some way; ***[3 max]***
Any other reasonable points.
*Award **[0]** if method for consumer (herbivore, carnivore) biomass is described.*

A2. (a) counting from aircraft / helicopter;
counting in sample areas / quadrats / transects;
and multiplying to calculate numbers in total area;
repetition of count over a number of years;
under similar conditions;
and at same time of year;
allow for animals not seen (*e.g.* young kangaroos in pouch); ***[4 max]***

The above is how this type of data are actually collected, but allow any reasonable suggestions, e.g. aerial photos, capture – mark – release – recapture (Lincoln Index), hunting/shooting records, population modelling.

(b) the number of different species present;
the relative abundance of each species; ***[2]***

Option B – Impacts of Resource Exploitation

B1. (a) (i) traditional cultivation in Philippines; ***[1]***

(ii) traditional agriculture uses less energy per unit area;
because of less intensive use of fertilizers / petrol (gasoline) / pesticides;
commercial agriculture uses more inputs per unit area;
traditional agriculturalists cannot afford expensive inputs;

energy yield ratio / energy efficiency more favourable in traditional agriculture;
but output per unit area much higher in commercial agriculture;
commercial agriculture uses larger fields / farms / paddocks;
commercial agriculture uses more capital / can afford expensive inputs;
traditional agriculture may be more sustainable / adapted to local conditions; ***[4 max]***
Any other reasonable points.
There must be at least one point of <u>comparison</u> for full marks.

(b) *may become more sustainable*:
through greater use of biological / integrated control;
greater use of organic farming;
increased affluence creates demand for organic foods / food produced sustainably;
reduction in consumption of meat, so cropping at lower trophic level;
shift to polyculture / agroforestry in some parts of the world;

or may become less sustainable:
increased populations require more intensive use of land;
greater use of pesticides / energy / fertilizers;
increased use of monocultures;
increased use of GM crops; ***[3 max]***
Allow either approach or a combination of the two. Some might argue that use of GM crops may allow disease-resistant, high productivity crops to be produced with fewer chemicals and therefore greater sustainability. Allow any reasonable points.

B2. (a) (i) the area of land (or land and water) required to support a defined human population at a given standard of living;
the measure takes account of the area required to provide all resources needed by the population and to assimilate all wastes *(based on Glossary definition)*; ***[2]***
Need not be word for word, but must show understanding of both points for full marks.

(ii) developed country's footprint usually larger;
more energy used *per capita*;
more food eaten;
higher proportion of meat in diet;
meat crops higher in food-chain so requires larger areas;
greater recreation pressures;
much more water used *per capita*;
much higher production of pollution (*e.g.* CO_2) / waste *per capita*;
e.g. air pollution by motor vehicles / solid waste from packaging; ***[4 max]***
Any other reasonable point.

(b) ***nuclear***

advantages:
relatively cheap to run, once constructed;
little atmospheric pollution;
radioactive byproducts for medicine;
require very small volume of fuel to run;
may produce military plutonium for weapons *(might be considered disadvantage, allow either)*;

disadvantages:
enormously expensive to construct;
technologically advanced, requiring particular type of manpower;
waste materials have very long life / half-life;
so disposal difficult and expensive;
dangerous to transport fuel and waste;
risk of terrorism;
decommisioning nuclear power plants may be difficult, expensive and possibly dangerous;
complex legal / health and safety procedures must be followed;
requires massive amount of cooling water;

coal

advantages:
may be cheapest to construct (may be appropriate for LEDC);
may be cheap to run, especially on or near a coalfield;
less sophisticated technologically (so may be appropriate for LEDC);

disadvantages:
produces air-pollution – sulfur-compounds / particulates *etc*. harmful to health;
– carbon dioxide which may aggravate "greenhouse" problem;
coal-mining has traditionally been dirty and dangerous;
large amounts of cooling water needed;

solar

advantages:
once constructed cheap to run;
no harmful pollutants produced;
make use of freely available resource in appropriate climates (many LEDCs are tropical / have arid/semi-arid climates with abundant sunshine);
do not require cooling water / fuel, so location may be flexible;

disadvantages:
cannot be used at night / in very cloudy weather / where there is little sunshine;
so not very useful at high latitudes;
expensive to construct;
technologically sophisticated;
often considered unsightly;
because useless at night, require batteries for storage; ***[6 max]***

Allow any other reasonable points. Reward detailed knowledge, particularly if related to specific examples or based on sound environmental understanding.

Option C – Conservation and Biodiversity

C1. (a) (i) *species diversity **[1 max]***:
the variety of species per unit area (this includes both the number of species present and their relative abundance) / *OWTTE*; *(Glossary definition)*

The response must have concept of unit area and/or relative abundance for the mark. "Number of species" is insufficient.

habitat diversity:
the range of different habitats in an ecosystem;
often associated with the variety of ecological niches / *OWTTE*; ***[2 max]***

(ii) *description **[1 max]***:
city has by far the highest biomass per square km;
city has highest density of population;
city has lowest biodiversity as absolute number of species and expressed as index;
i.e. a small number of common species are very abundant;
forest has lowest biomass;
and population;
forest biodiversity is high, but not as high as farmland;
i.e. a wide variety of species, none of which is very abundant;
farmland has much lower biomass than city, higher than forest;
farmland has lower population than city, higher than forest;

explanation:
city is a specialized environment that a few species can exploit very well;
food from gardens, rubbish (garbage) *etc*. may be available to support some species;
city has low habitat diversity/low number of ecological niches;
forest is a multi-layered habitat, with a variety of plant species, so habitat diversity is high;
farmland may have highest habitat diversity of all, having both natural and artificial habitats;
some food from human sources may be available in farmland (crops);
the diversity index of the three environments takes account of the species diversity and the relative abundance of the species, hence farmland highest; ***[4 max]***
Any other appropriate point.
At least two "explain" points needed to achieve full marks.

(b) (i) the process through which new species form / *OWTTE (Glossary)* / the process by which change in the frequency of genetic trait occurs (in response to environmental pressures); ***[1]***

(ii) individual organisms in a population vary;
natural selection = the tendency of those organisms most adapted to / fittest for environment to survive;
and therefore to pass their characteristics to their progeny;
thus organisms become increasingly adapted to their environment;
a changing environment may affect speciation / evolution;
mutations may affect rate of speciation;
appropriate example; ***[2 max]***
Reward any two of the above points or any other reasonable points.

(iii) isolation of a small sub-group of the original population may encourage / accelerate speciation;
through impossibility of interbreeding / exchange of genetic material with original population;
and adaptations to new environment;
entirely new endemic species / unique species not found elsewhere may appear;
e.g. unique finches / tortoises / iguanas on Galapagos Islands; ***[2 max]***
Any other reasonable point.

C2. (a) (i) name and brief description;
e.g. woodland near Underwood Avenue: a fragment of urban bushland in Perth, Western Australia; ***[1]***

(ii) name of human activity;
e.g. threatened with clearance for housing development; ***[1 max]***

(iii) *effect on biodiversity*:
may destroy flowering trees / shrubs (*e.g.* Banksias) and nectar-feeding birds dependent on them (*e.g.* honey-eaters, wattle-birds); ***[1]***

(b) Convention on the International Trade in Endangered Species (of Wild Fauna and Flora) / an international agreement / treaty aimed at preventing trade in endangered species of plants and animals;
thereby reducing demand;
and contributing to organisms' conservation;
e.g. ivory / rhino horn / many marine turtle species / many species of parrots; ***[3 max]***
Any other reasonable point.

(c) very small population numbers;
slow reproduction rate;
specialized habitat;
habitat under threat;
long / complex migration routes;
under human pressure from hunting / collecting / trade;
high in food pyramid;
appropriate example (whooping crane, Carnaby's cockatoo, Asian rhino); ***[3 max]***
Any other reasonable point.
Note*: example not essential to receive full marks.*

Option D – Pollution Management

D1. (a) (i) *point source pollution* ***[1 max]***:
the release of pollutants from a single easily identifiable site *(Glossary)* / *OWTTE*;
e.g. factory chimney / waste disposal pipe into a river;

non-point source pollution ***[1 max]***:
the release of pollutants from numerous, widely dispersed origins *(Glossary)* / *OWTTE*;
e.g. gases from the exhausts of numerous vehicles / fertilizers leaching into water bodies from a wide area of farmland; ***[2 max]***

To receive ***[2 max]*** *a definition* ***and*** *an example of each source are required.*

(ii) point source pollution, because is possible to locate and take practical / legal steps to control the release of pollutants from a single location, or a few locations / *OWTTE*; ***[1]***
Must have type of pollution and reason to receive the mark.

(b) (i) large increase in use of N;
slight hesitation in rate of increase of N in 1940s;
increase in K less;
increase in P much less;
increase in P from a slightly higher base;
P use steady since 1940s;
slight recent downturn in P use;
K use steady since 1960s;
slight reduction in K use in late 1960s and early 1970s; ***[3 max]***
Any other reasonable point.

(ii) improvement in growth of crops;
extension of agriculture into previously unsuitable areas / infertile soils;
eutrophication of water bodies;
algal blooms in water bodies;
reduction in oxygen content of water bodies;
death of fish / other aquatic life;
unpleasant smells;
increased use of energy in manufacture / distribution of fertilizers;
depletion of phosphate / potash resources (Christmas Island, Nauru); ***[4 max]***
Any other reasonable points.

(c) *This question will be answered with reference to a variety of pollutants. Award* ***[1]*** *for each of the following points,* ***[6 max]****.*
reduction by changing activity;
changes in lifestyle to reduce demand for process producing pollutant;
alternative cleaner / more efficient processes;

regulation of pollutant at source of emissions;
monitoring;
setting limits / legal standards;
methods of extraction of pollutant from waste stream;
e.g. using scrubbers;

clean-up after pollution;
methods of extraction of pollutant from ecosystem;
e.g. chemical treatment / bioremediation;
restocking of organisms; ***[6 max]***
Any other reasonable points.

D2. (a) an indirect measurement of the level of pollution using organisms (based on their number and abundance) / *OWTTE*; ***[1]***

(b) *Allow any reasonable example e.g.*
lichens are very sensitive to atmospheric pollution;
and so counting of numbers of species of lichens;
noting certain indicator / critical / key species;
on walls, rocks, roofs in and near an urban/industrial area can give information on pollution;
low number of individuals and species suggests high pollution; ***[3 max]***